MODERN PLASTICS

AUGUST 1960

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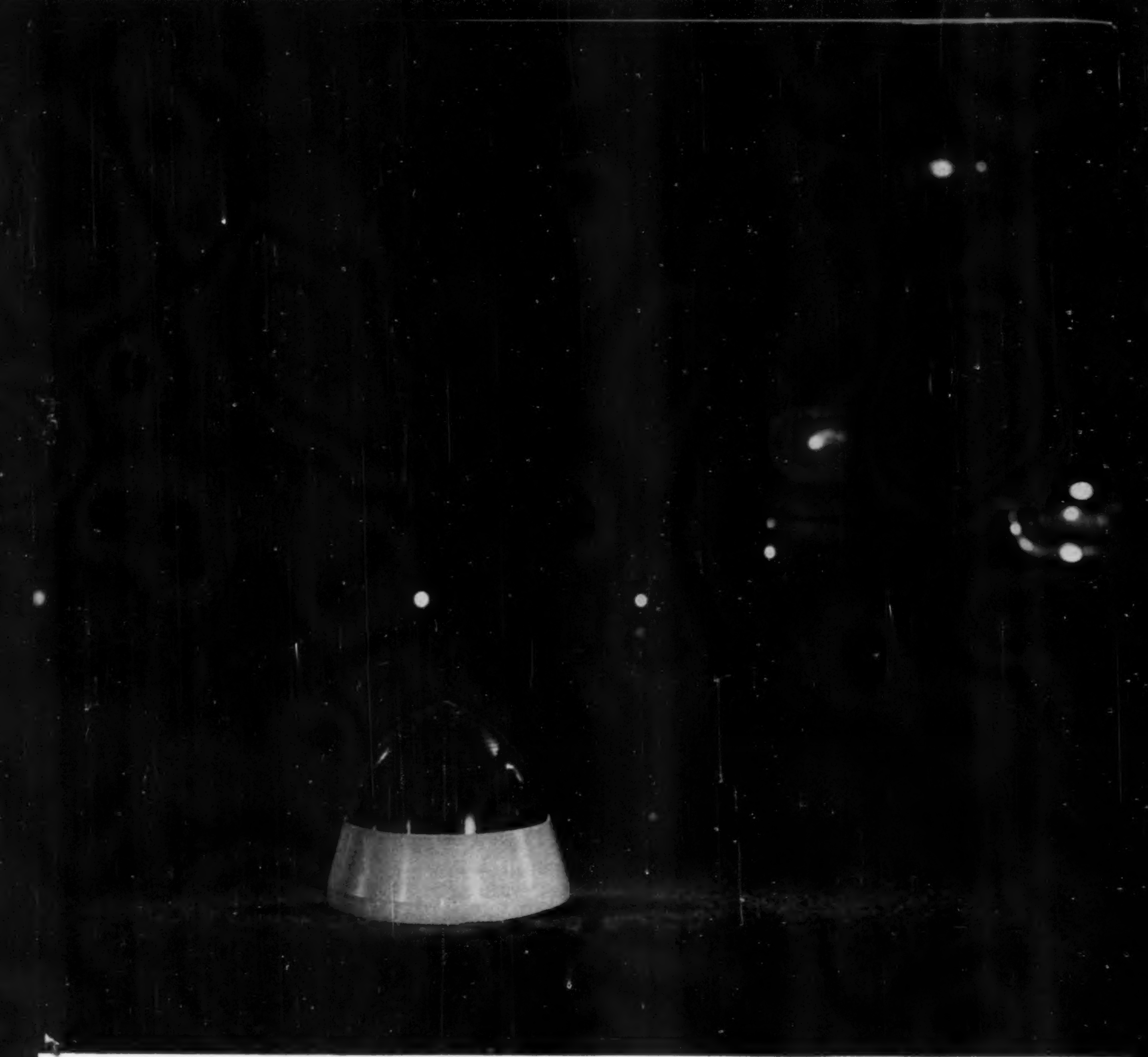
A practical guide to film winding *p. 105*

How and when to use pressure forming *p. 85*

Special preview: the Dutch macroPlastic exhibition *p. 143*

Film laminations—applications, markets and costs *p. 79*



MODERN

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• **THE PLASTISCOPE**

Section 1 . . . . **41**
Section 2 . . . . **202**
Significance of the nylon price decline (p. 202); consumption of styrene-type molding materials (p. 41); growth of polystyrene production (p. 43); new fluorocarbon film (p. 204); new plastic netting (p. 45).

• **EDITORIAL**

Plastics in the new nations **248**
How the underdeveloped nations, with teeming population and great resources, can go about developing plastics industries of their own . . . and traps they must not fall into.

• **GENERAL**

For versatility unlimited: film laminations **79**
Through various combinations of the 30 or so plastics and non-plastics films currently available, it is possible to produce millions of different laminations. Not all combinations are feasible, but a sufficiently impressive number has been developed to present today's manufacturer with a real problem when choosing between the various constructions. What are the most important of these laminations? What films are involved? Where are they used? What can they do? How much do they cost? Who are some of the laminators? What are the future markets now shaping up? Here are the answers to these questions.

When and how to use pressure forming **85**
The many new materials introduced over the past few years have presented a strong challenge to the thermoforming industry. Standard vacuum forming processes were not capable of handling many of them, and new methods had to be developed. One which has now been perfected is pressure forming. Initial markets are in the packaging field, but other applications loom large: automotive parts and refrigerator door liners and shells. This article presents a summary of the machines available, operating conditions, and tools designed for this process.

Air conditioning with polyester bags . **88**
Jet passenger comfort is improved and installation time cut by 20% through the use of fabricated polyester bags installed in the walls of a plane. In addition, air leakage, which previously had been on the order of approximately 30 to 40%, is completely eliminated.

New competitor for decorative laminates: DAP **90**
Requiring relatively low pressure, diallyl phthalate-impregnated papers can be applied directly to wood veneers or other cores in simple, one-step operation that can spell economies for users. On the average, total cost of laminating with the new system comes to about 5¢ per sq. foot. Several manufacturers in the home and office furniture field have already switched to the new system. Other markets include paneling, school desks, counter and dinette tops, and institutional fixtures. Two representative case histories are given.

Bright days ahead for plastics in lighting **94**
Materials developments resulting in non-yellowing and flame resistant formulations, plus design progress utilizing to the fullest the properties of plastics, have created an upsurge of plastics in lighting applications. Selling at less than $1 per sq. ft., compared to $1.25 for glass, plastics lighting components now offer real economies to the user—quality without compromise. Tabulation gives properties and comparative costs of the most commonly used materials.

Plastics in the product revolution: Fishing tackle **98**
Perhaps in no other industry's products have so great a variety of plastics been applied so extensively as in fishing tackle. From the first plastics usage (phenolic-impregnated bamboo) to the latest foam lures, angling equipment has turned increasingly to plastics for better performance and lower cost. Here we trace the major developments, covering every phase of a sport claiming 40 million devotees.

Switch from steel to polyester cuts tank cost 25 percent **101**
How 4-ft. component for home water softening system, molded in matched metal dies of glass-reinforced bisphenol-A polyester, licks corrosion problem, saves money, too.

Modern Plastics Executive and Editorial Offices: 575 Madison Avenue, New York 22, N.Y. Please mail all correspondence, change of address notices, subscription orders, etc., to above address. Quotations on bulk reprints of articles appearing in this issue are available on request.

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PLASTICS*

AUGUST 1960
Volume 37 Number 12

Previewing macroPlastic **143**
The second international plastic exhibition, macroPlastic, to be held from October 19-26 in Utrecht, Holland, is previewed by three authorities in the Dutch plastics industry. Also presented is the preliminary program of the International Congress on the Technology of Plastics Processing to be held October 17-19 in Amsterdam, and an alphabetical list of exhibitors.

New developments **168**
Small styrene parts—large economies . . . Thermoformed PE hats . . . Foamed-in-place buoyancy . . . High-density PE in housewares . . . Acrylic shell protects toll booth . . . Impact styrene standoff clips have molded-in nails . . . Prepreg repairs ductwork . . . Phenolic-handled cutter doubles as server . . . Vinyl film in surgery . . . Reinforced Teflon gaskets . . . Dogwood shuttles to plastics.

• ENGINEERING

A guide to winding—Part I **105**
A properly wound, neat, and attractive roll of film can bring added profits. Here are the engineering principles involved and the major items of equipment needed to do the job right. Covered are web tension, web width and thickness, roll and core diameter, integrated winding procedures, drives, and winders. This is the first article in a 2-part series. The second will deal with accessories and equipment cost, as well as the economics of winding. *By Stewart F. Oakes and Alfred A. Arterton.*

Field erection of plastic shelters . . . **113**
Shelters for personnel and electronic gear involve the use of inflatable reinforced Mylar mold and a group of guns that spray polyester mix and glass. Selection of mold and mold materials as well as erection and rigidizing of shelter are analyzed. Step-by-step procedures on the actual fabrication of a prototype Quonset-shaped shelter are given. *By Anthony F. Gurdo, Joseph M. Schramp, John E. McCormick, and George J. Stabler.*

• TECHNICAL

Differential thermal analysis **125**
DTA is a technique developed by ceramists and mineralogists to study physical and chemical phenomena when materials are heated. The same system can be used to study the chemistry and properties of plastics. This article describes use of DTA in the identification of polymers, the determination of degree of cure, catalyst effect on cure, and irradiation effects. *By C. B. Murphy.*

An all-hydrocarbon thermosetting resin for electrical insulation **132**
New material has high heat resistance, low loss factor, and dielectric constant, very low water absorption, high dielectric strength, and good arc resistance. The resin has been processed as castings, single-stage-cured reinforced panels, B-stage cured, and laminating solutions. *By Hadden Clark and R. G. Adams.*

• DEPARTMENTS

New Machinery–Equipment **48**
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Coming Up . . .

What is the outlook for the "Giant Thermoform?" Our September lead analyzes the new materials and techniques that foreshadow a breakthrough. Possible economics are spelled out through recent applications, and work still to be done is outlined. . . . Engineering lead reveals a new method for producing reinforced plastics pipe *continuously*. . . . Cold formed polycarbonates are the subject of our Technical Section lead . . . In the works is a detailed study of vinyl applications in the building industry . . . New ways of forming polystyrene, including electronic, injection, extrusion. . . . Progress in ablation materials.

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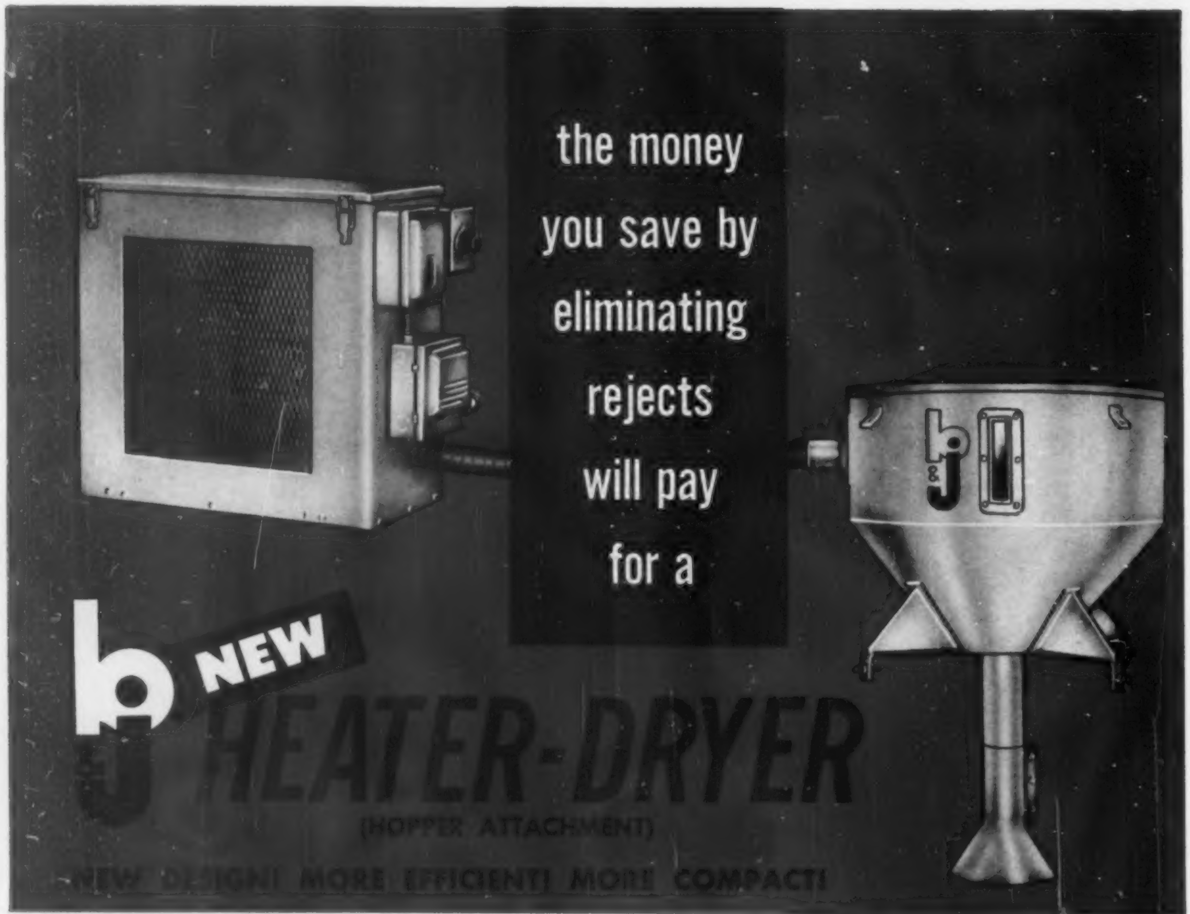

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Brittleness	~~Im[illegible] w[illegible] due to c[illegible]al~~
Moist surface or cloudiness	~~[illegible]ri[illegible] m[illegible] [illegible]rope[illegible] [illegible]d~~

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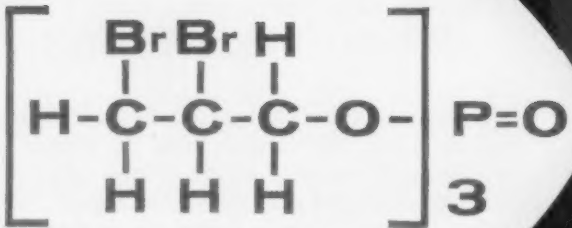
Flame retardant for plastics



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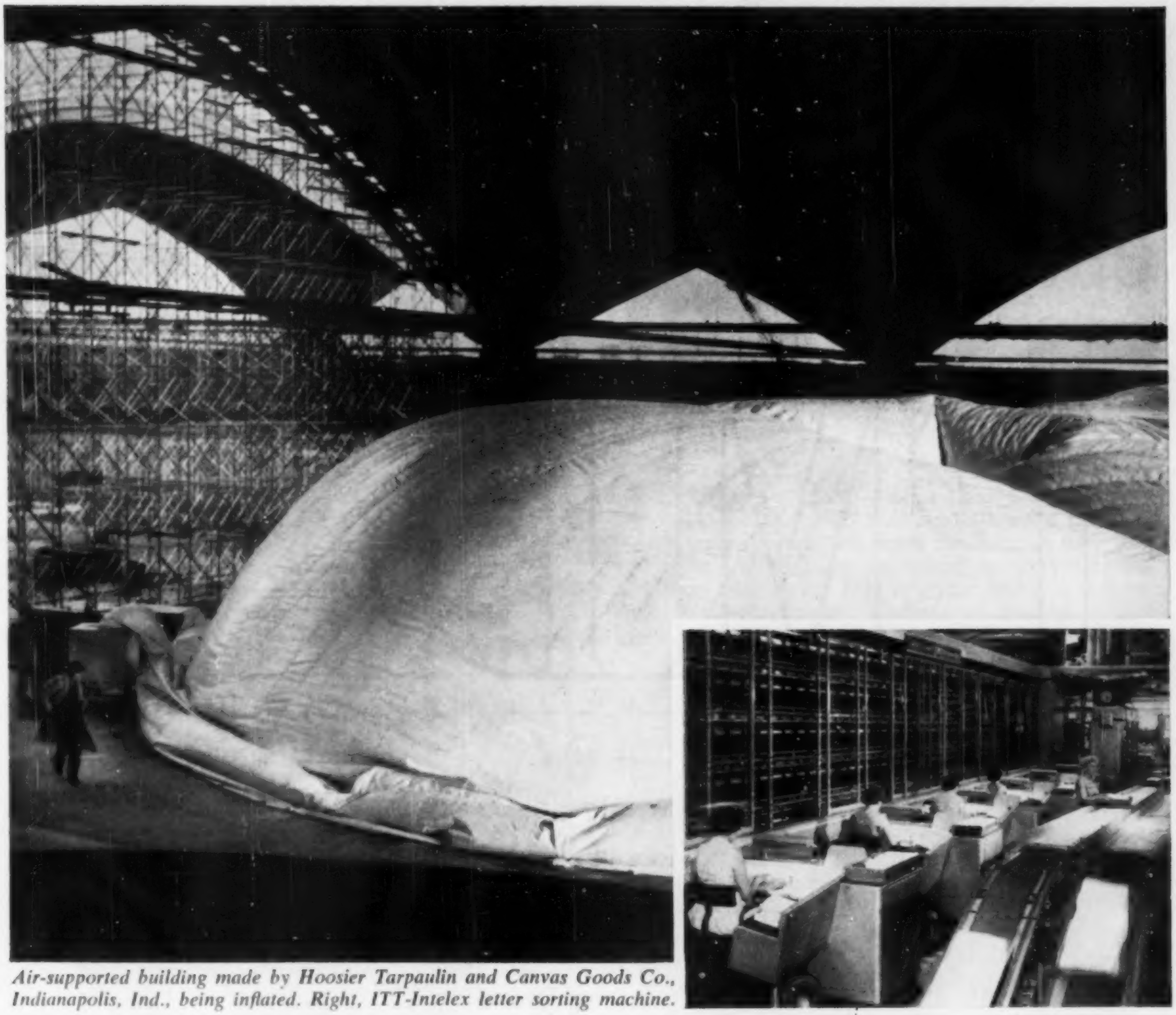
Huge fabric building speeds construction of first push-button post office



Air-supported building made by Hoosier Tarpaulin and Canvas Goods Co., Indianapolis, Ind., being inflated. Right, ITT-Intelex letter sorting machine.

The world's first fully mechanized post office—a "laboratory for the future" which promises to revolutionize mail handling—is scheduled for completion in Providence, R. I. this October.

To meet this deadline, sensitive electro-mechanical machinery for sorting letters at high speeds had to be installed even before the walls of the building went up. The problem: How to protect it during installation?

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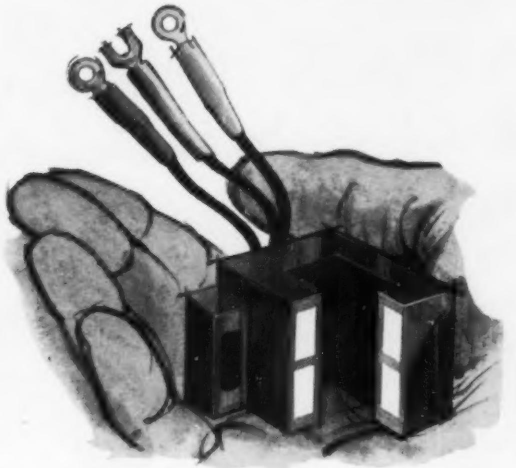
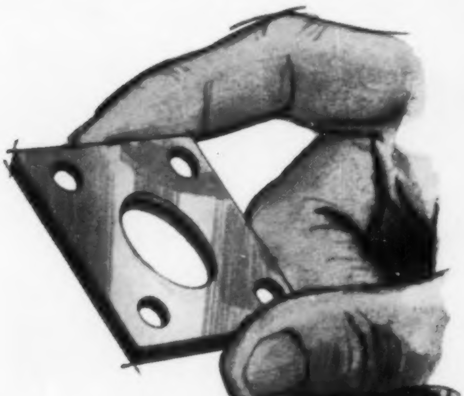
TECHNICAL DATA are available to help you apply PMDA to your curing problem. For copies of these bulletins, write to Du Pont, Explosives Department, 6539M Nemours Building, Wilmington 98, Delaware.

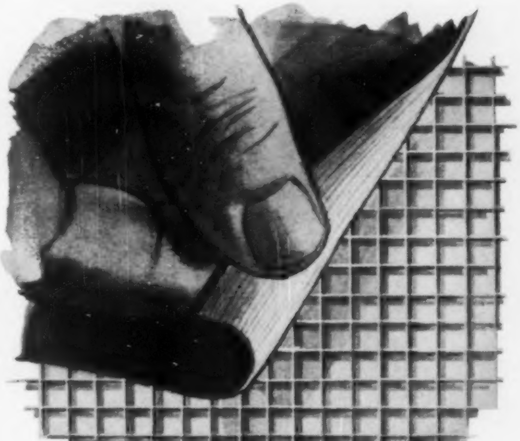


IN CASTINGS AND POTTINGS Heat distortion temperatures above 500° F. can be achieved readily in conventional epoxy resins cured with PMDA. Electrical properties are excellent over a wide range of frequencies and temperatures.

IN COATINGS Epoxy coatings based on PMDA-glycol adducts have an excellent balance of physical and chemical properties—hard but flexible; excellent adhesion and abrasion resistance; good solvent and chemical resistance. PMDA-glycol adducts can be used for baked epoxy coatings or coatings which cure at room temperature.



IN LAMINATES Glass-reinforced resins cured with PMDA retain good flexural and tensile strengths after 1,000 hours at 500° F.



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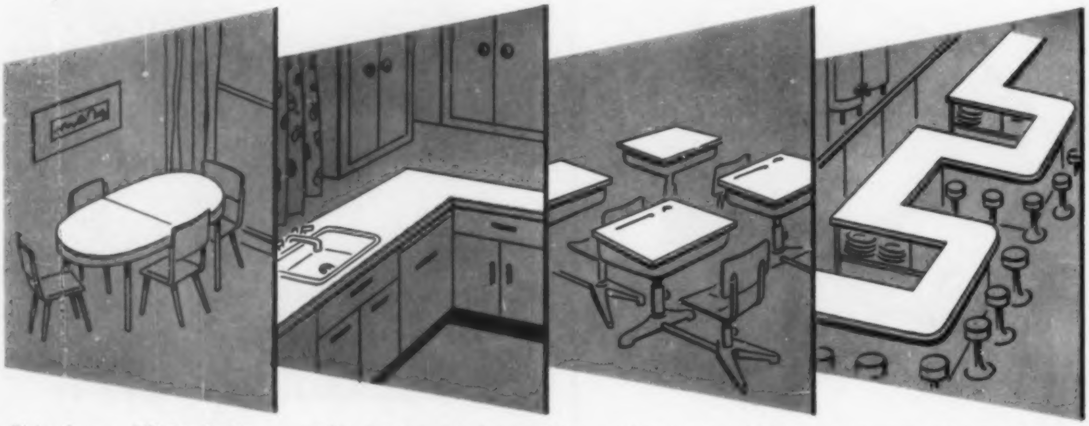

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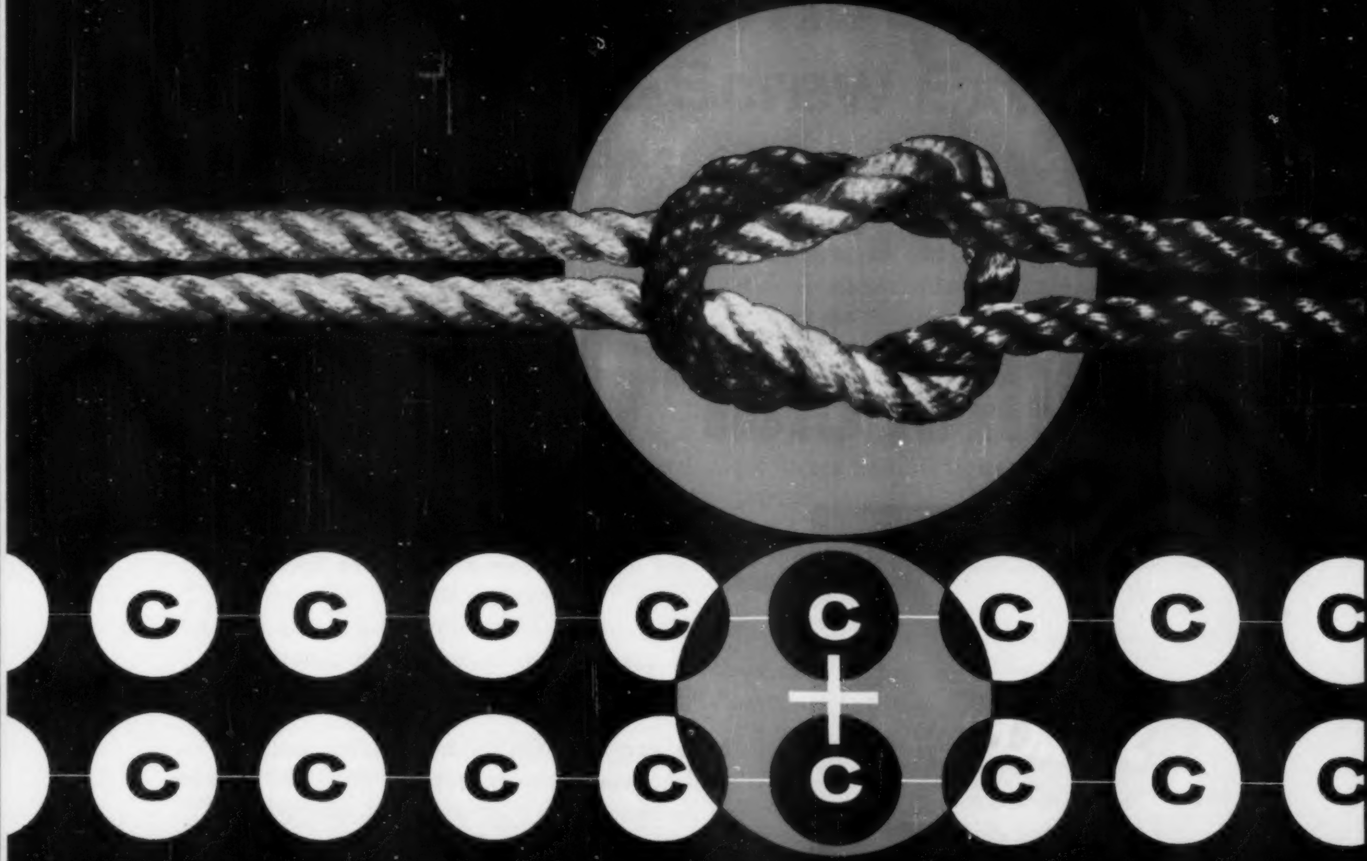

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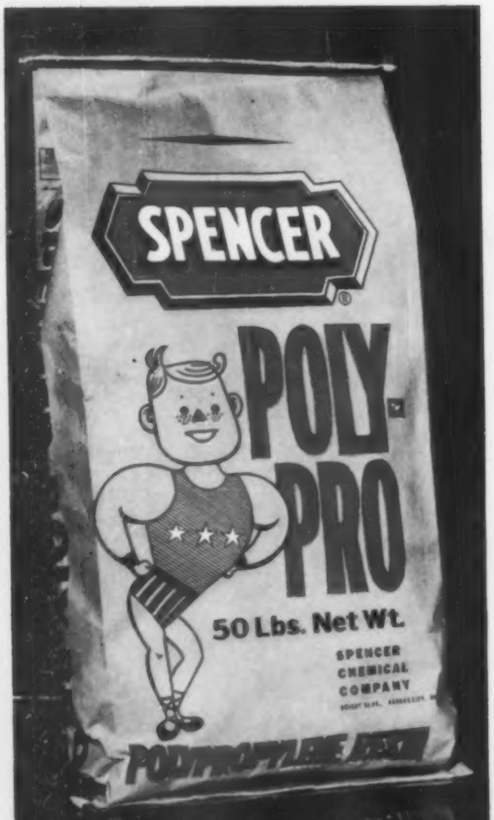

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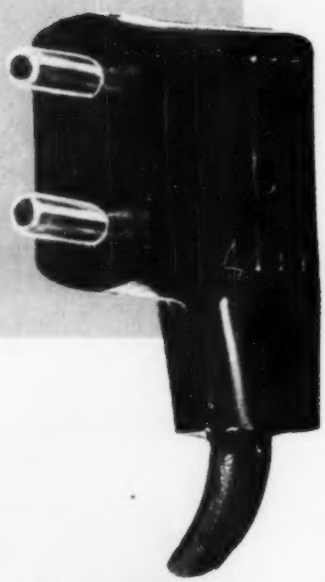

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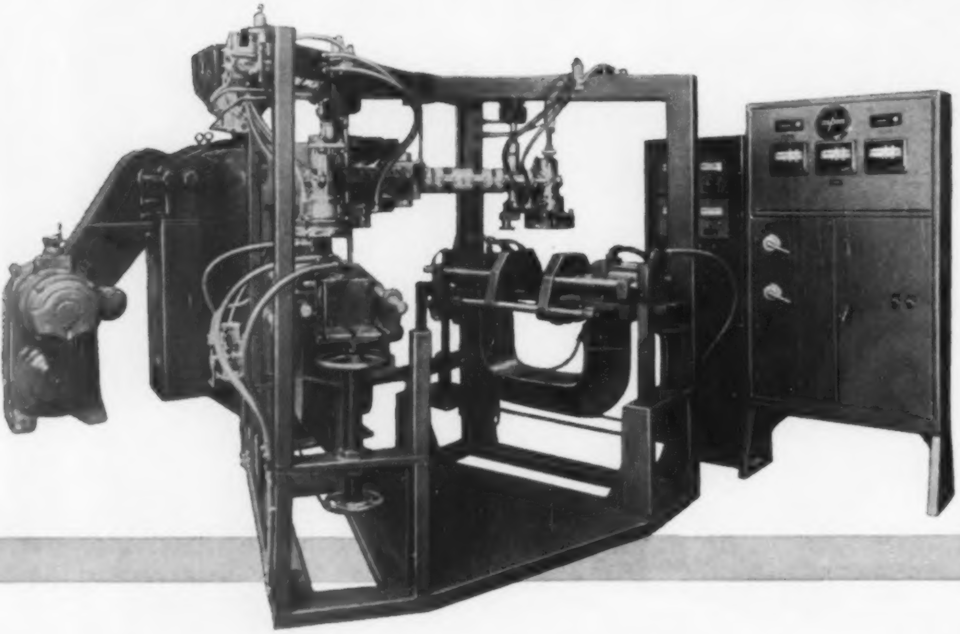

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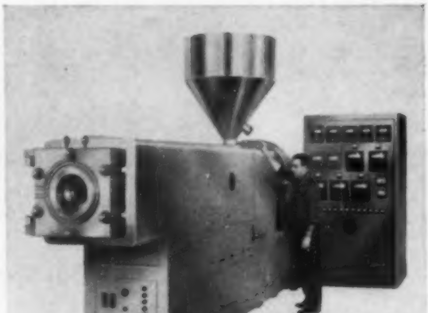

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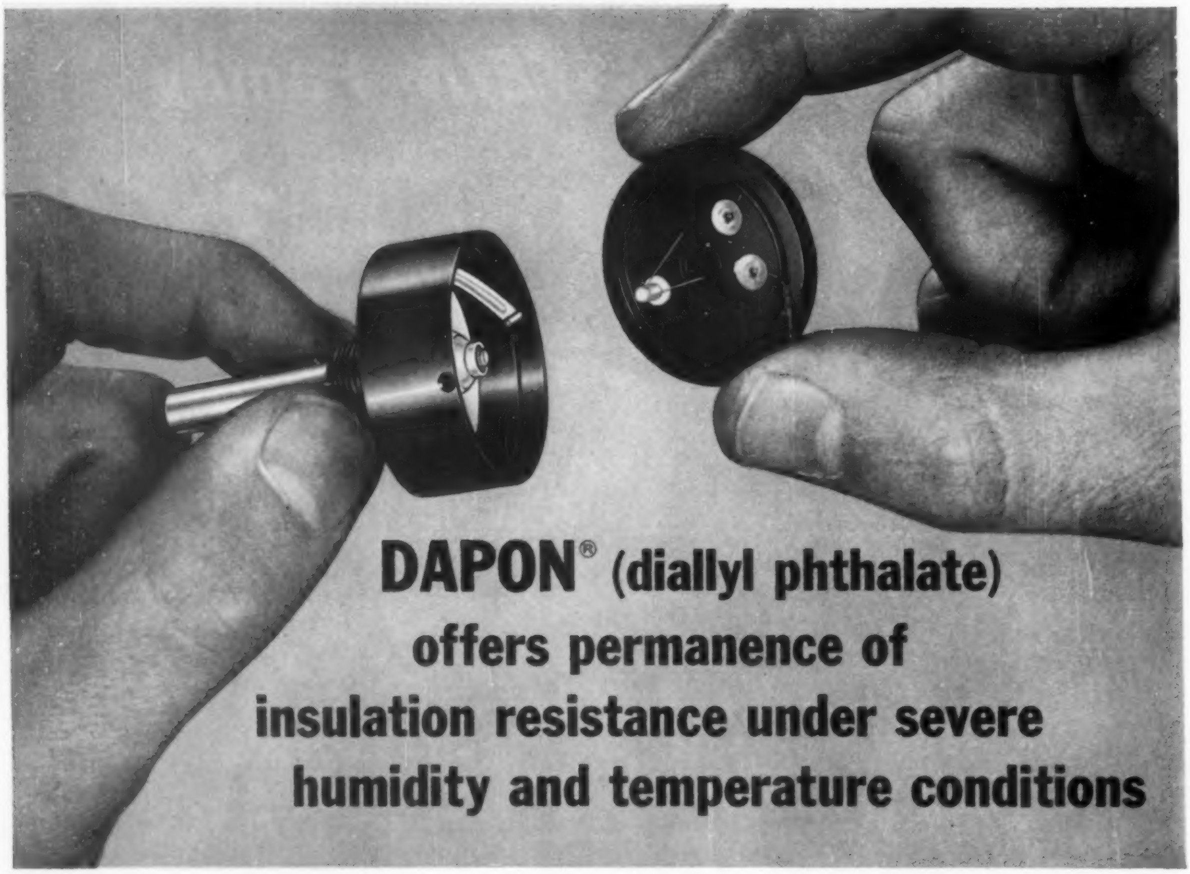

DAPON® (diallyl phthalate) offers permanence of insulation resistance under severe humidity and temperature conditions

This plastic is ideal for applications where changes in humidity can affect electrical values. DAPON can prevent costly "in service" failures in electrical and electronic components.

A new molded plastic potentiometer produced by New England Instrument Company features exceptional resistance to humidity, high reliability and low noise. A raised conductive plastic ring is used in place of resistance wire in these miniature units. The new potentiometers are ideal for servo and instrumentation applications where long life and extreme accuracy are important factors.

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New England Instrument chose DAPON because of its superior electrical and physical properties, and its low moisture absorption. DAPON also molds easily around metal inserts without cracking, and withstands extremes of temperature, vibration and shock.

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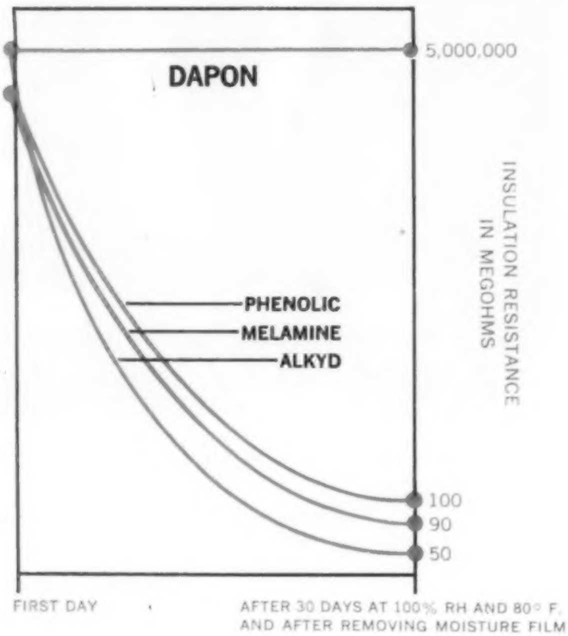

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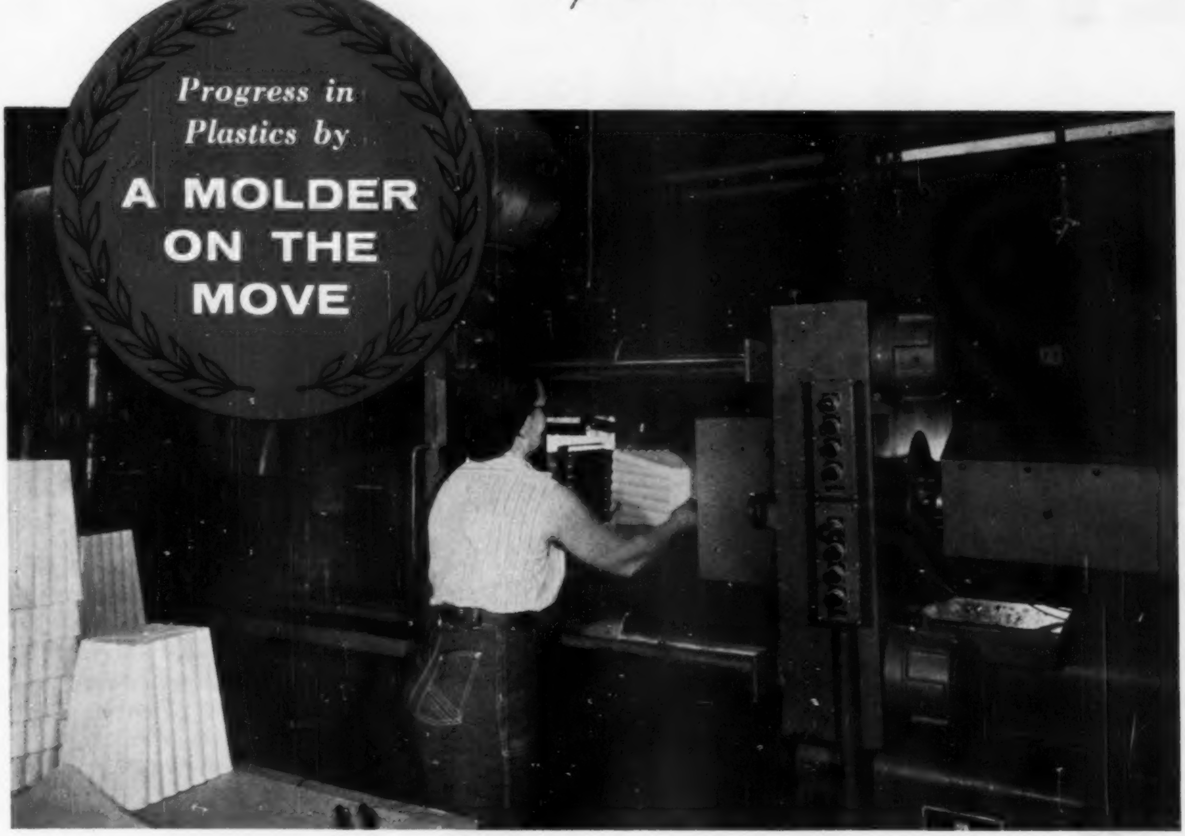
"Since installing our new H-P-M 12/16 oz. injection molding machine our production on each mold that was run has increased 15% to 30%. The ease with which the molds are installed has cut many hours from set-up time. We are very pleased with this new machine."

Fred Kottman

Fred Kottman
BW Molded Plastics



15.25 OZ. SHOT ON A 12 OZ. MACHINE

Production on this basket at BW Molded Plastics in Pasadena, illustrates why molders everywhere are endorsing the H-P-M 12/16 oz. machine. Production up 15% to 30%, a full 15.25 oz. shot on a 12 oz. machine; set-up time has been reduced which means more productivity per day and more profits from the same fixed costs. Small wonder the new "12/16" is called the biggest buy in the business.

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- Unitized press and generator construction for greater efficiency.
- Pre-heat, heat cycle and dwell timers for increased production and greater control over products.
- Swivel hood protects precision ground double "V" gibs and slides.
- Complete manual control over raising or lowering press to any position to facilitate die mounting.
- Chrome plated quick-leveling device for dies.
- Automatic 2-hand push button operation.
- Easy to move — Has heavy duty casters.

These completely self-contained heavy duty machines are modern all the way through, both electronically and mechanically. Superbly engineered to give you superior performance and simplified, lower cost operation. Among the many features found in WELDOTRON generators are a fully filtered power supply and one-knob DC power control for any level between zero and the full rated power. Press incorporates double "V" gib and slide construction — the optimum in press design. Built-in safety factors throughout!

Whatever your plastic product, whatever your production rate, there's a WELDOTRON unit ready to do the job the way you've always hoped it could be done. Models from 1.5 to 20 KW. Please write for complete information to Section **MP-8.**

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The oldtime minstrels didn't know what they were missing. No question that Mr. Bones & Co. could make a banjo sing and ring with a beat perhaps no one today can duplicate. Today's better banjos, however—like the new 4- and 5-string instruments developed by The Harmony Company, Chicago—have qualities even the greatest of the old-timers would have appreciated.

Advanced, professional-type Harmony banjos utilize modernized banjo construction. A new, solid, non-warping "Reso-Tone" rim and resonator molded of Plenco Phenolic Compound 345 Oak Mottle helps assure superior tone and powerful banjo "ring and snap." The tone is amazing, say professional artists.

This Plenco material offers Harmony properties of excellent stability as well as fast cure, smooth mottle-pattern finish, good impact characteristics, and tensile strength. It's one of a series of formulations use-proved, notably, in the manufacture of radio and television cabinets. A wide variety of Plenco phenolic compounds—*ready-made or specially-made*—is available for general and special-purpose applications in *all* industries. They could add new "ring and snap" to your own product, new ease and economy to your production. We'd like to show you.

PLASTICS ENGINEERING COMPANY

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PLENCO PHENOLICS FOR BETTER PLASTIC PRODUCTS

Joe Foster, President, discusses Foster Grant's pioneer experience with bulk handling polystyrene.

"Our Experience in Bulk Handling Polystyrene Can Bring You Carload Savings," says Joe Foster.

As the world's largest manufacturer of sunglasses, we've known the advantages of bulk handling polystyrene since it was first introduced... learned how handling, operating expenses and production overhead could be saved with this unique method of storing polystyrene in quantity.

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If you would like to know more about bulk handling polystyrene and the savings in time and money it can mean, just call or write Foster Grant Co., Inc., Leominster, Mass., KEystone 4-6511. We're ready to go to work with your staff right now!

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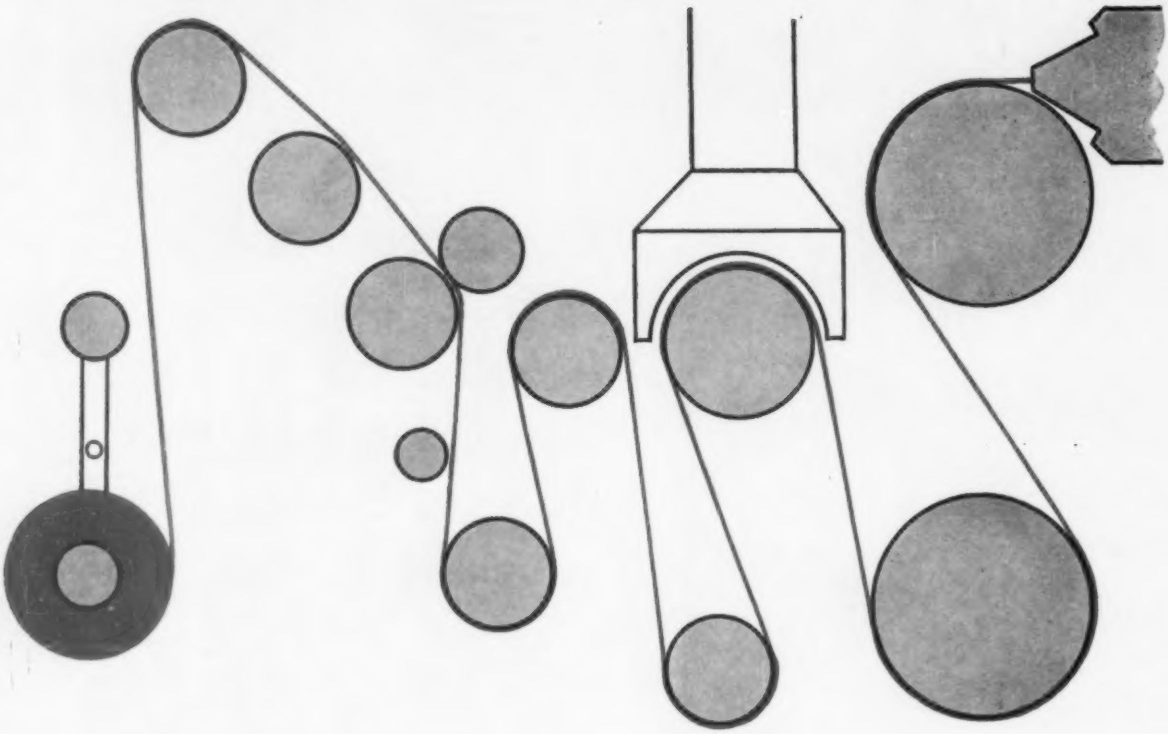
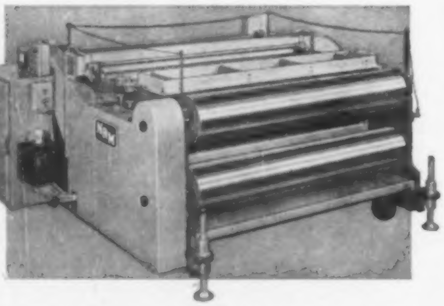


NRM FILM CASTING UNIT

...for operation at speeds up to 500 fpm



NRM's film casting unit is offered for production of standard film widths from 36 to 72 in. — wider upon request. Features include turret-type wind-up with constant tension wind-up control, automatic hot knife cut-off and transfer, variable width knife slitting and an integral trim collector ducted for connection to collector or granulator. The unit can be track or floor mounted.

Based on an extensive survey of the industry's needs, NRM's new unit is designed for high speed, efficient casting of 0.0005 to 0.010 in. conventional or linear polyethylene, polypropylene or nylon film. Suitable for installation of a built-in electronic treating device, the machine can produce high-clarity film, ready to print without reprocessing.

Rolls are spiral baffle liquid-chilled, chrome plated and highly polished for production of blemish-free film. Dynamic balancing of all rolls assures vibration-free, true running at highest processing speeds. And, all idler rolls are drilled for optional liquid cooling.

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Find out how this new unit can improve the quality and quantity of your cast film production. Call, wire or write NRM today for application engineering recommendations.

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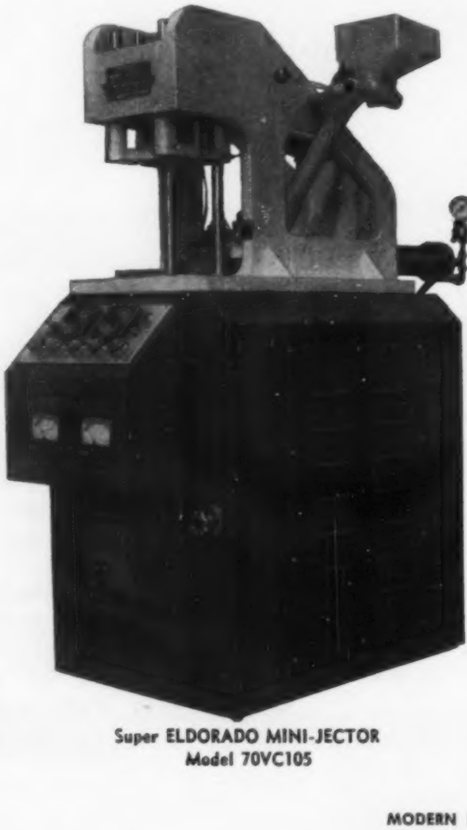
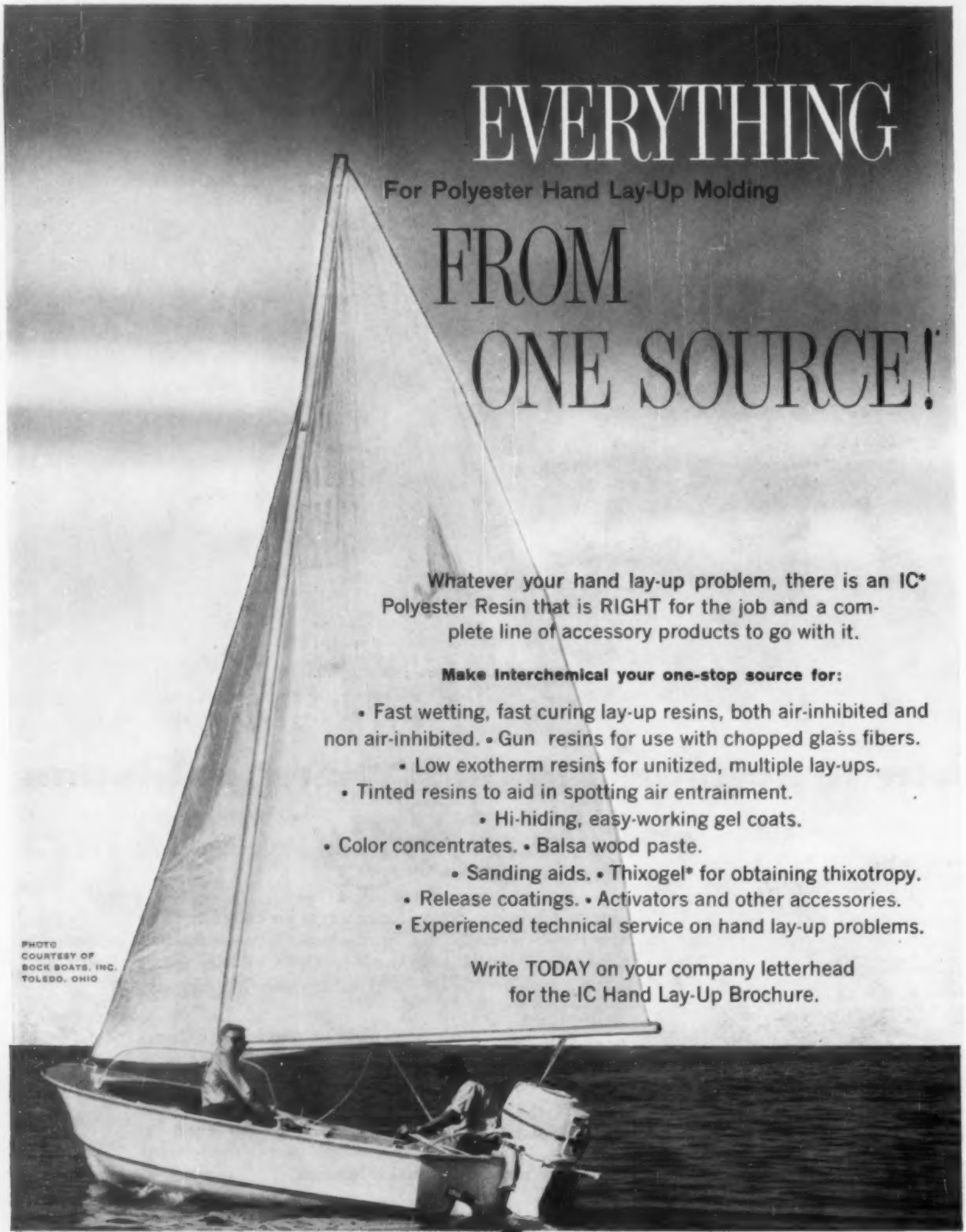


Super ELDORADO MINI-JECTOR
Model 70VC105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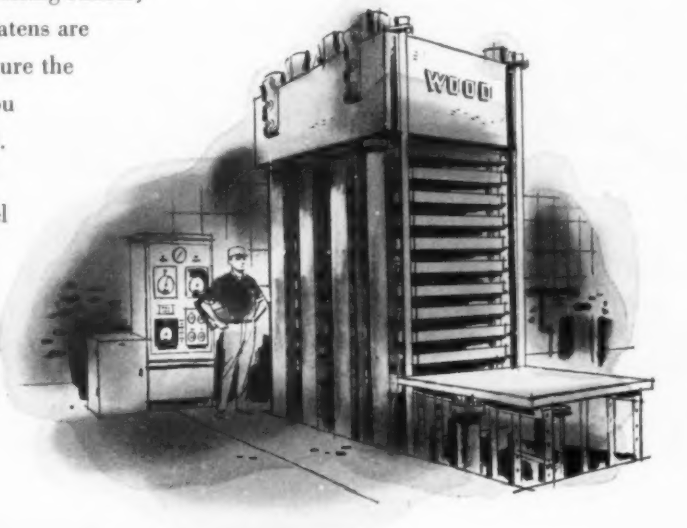

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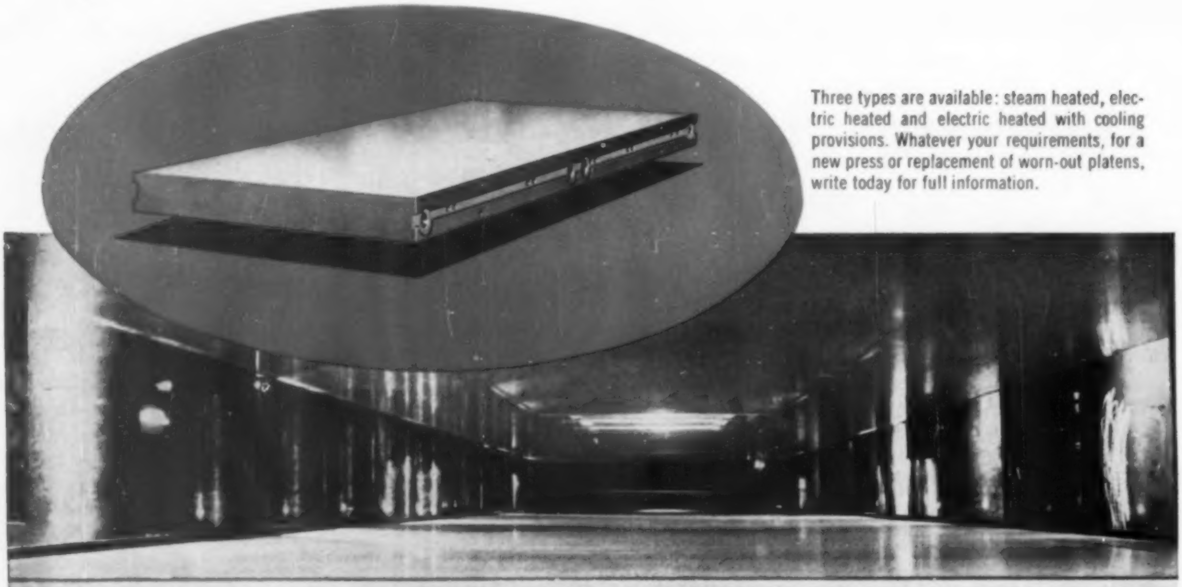

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THE PLASTISCOPE*

News and interpretations of the news — By R. L. Van Boskirk

Section 1 — **August 1960**

Polystyrene growth pattern. Consumption of styrene-type molding materials for first six months of 1960 was about the same as in 1959, but will have to pick up considerably in the next six months if 1960 volume is to increase by the 10 or 12% which producers are predicting. The last six months of 1959 were whoppers, and May and June of 1960 have dropped under the same months of 1959. These figures are based on Tariff Commission reports, except June, which is not yet published and must be estimated.

The Commission's reports show that about 183 million lb. of styrene-type molding material were consumed in the first four months of 1960, compared with 178 million in the same period of 1959. But there were over 201 million lb. consumed in the last four months of 1959, with a high of over 55 million in October. The second four-month period, May through August 1959, saw about 181 million lb. consumed. Consequently, it can be seen that even though the first period of 1960 was ahead of the same period in 1959, the momentum of last fall's push has lost its drive. There have been no 50-million-lb. months in 1960, with April 1960 leveling off to about the same as in 1959, and May dropping to 46.6 million in 1960, compared with 47.9 in 1959.

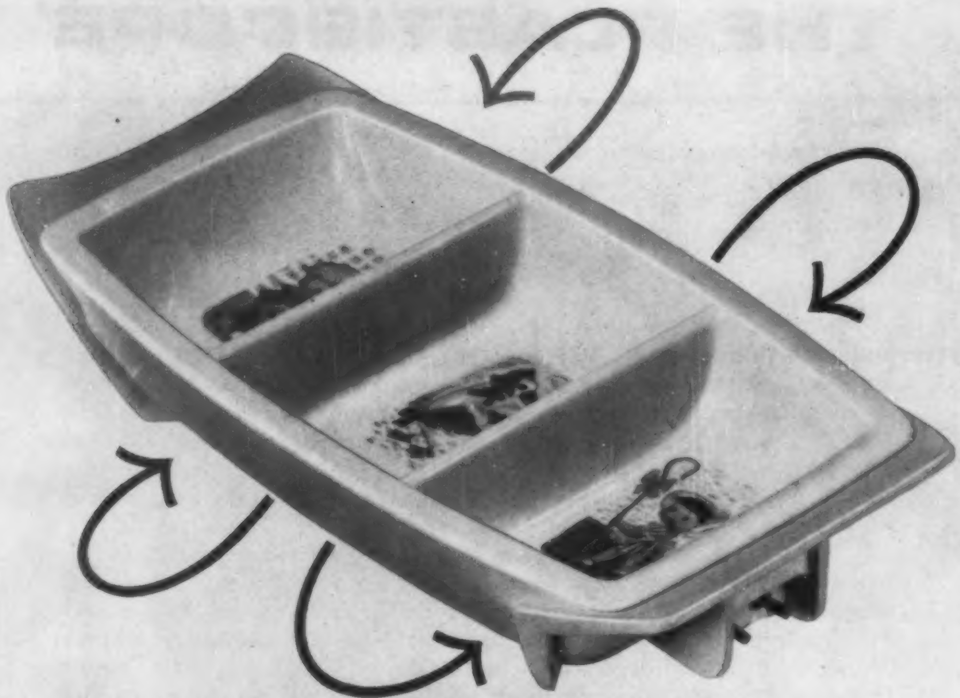
The June through August period is generally low in the plastics industry, and there is some indication that it will be the lowest period in 1960. Most businesses, however, are expecting a pick-up in the fall and a rebuilding of inventories that have generally declined since the effect of last year's steel strike which created an over-build-up of inventories. Furthermore, there is almost never a decline in business during an election year. Yet, despite all these omens and happenings, it is difficult to foresee how polystyrene molding material can increase enough in the last half-year of 1960 to make the year's total much higher than 1959—the first half just wasn't big enough.

General purpose vs. impact styrene. Although there has always been an inclination in some circles to credit the increased sales of polystyrene to a price decline, this observer has always maintained that a great portion of the credit should go to impact styrene.

It is not possible to obtain an accurate figure on impact styrene because the Tariff Commission figures also include the various styrene copolymers. Estimates on copolymer sales range from 3.5 to 5 million lb. a month. Based on this reckoning, the amount of impact styrene sold in the U. S. in 1959 was from 260 to 270 million pounds. The Tariff Commission's report shows 248 million lb. of general-purpose polystyrene but this did not include 35 million or more sold by companies who do not report or report only on an annual basis. Thus impact and general purpose were close to 50/50 in 1960.

Trying to discover what happened to this division in early 1960 is difficult, since 2 or 3 million lb. a month of general-purpose polystyrene won't be reported until the end of the year. But the companies who didn't report in 1959 are the same ones who didn't report in 1960, with two or (To page 43)

*Reg. U. S. Pat. Off.



THE PLASTISCOPE

(*Continued from page 41*)

three small-volume additions; consequently, the Tariff Commission figures can be used to show the trend.

The report shows that 85 million lb. of general-purpose polystyrene was sold in the first four months of 1960 vs. 80 in 1959. "Other type" polymers were 99 in 1960 vs. 101 in 1959. Deduct 12 to 15 million lb. for copolymers and there would be 85 or so million lb. of impact sold in 1960, or little if any increase over 1959. This is confirmed by statements from several producers who noted that general-purpose polystyrene is moving more briskly than impact. Yet the May report gives other polystyrenes at 27.1 million, compared to 19.5 for general purpose. At any rate, the total for "other types" in the first four months of 1960 is about 99 million, compared to 114 million in the last quarter of 1959. The reason is generally placed at the door of the refrigeration industry, where production is down and, furthermore, no one is sure how these figures have been affected by growth in the copolymer field.

Other factors in styrene polymer progress. Growth of polystyrene production has apparently not yet affected U. S. exports of this material. Exports of molding material alone in 1959 were thought to be between 80 and 90 million lb., and figures so far reported indicate that the total may be 110 million or more in 1960. Steady growth from around 30 million in 1954 indicates that the market for American styrene-type resins in foreign countries is far from satiated. It is believed that less than a fourth of the exported resin is impact or copolymer material. Analysts have quit trying to predict when it may start to decline from competition with other countries. This export material is not reported as a molding powder in the Tariff Commission's survey but is listed with "all others."

Polystyrene foam, now thought to be in use at a rate of from 45 to 60 million lb. a year, and expected to reach 150 million in 1964, is also supposed to be listed in the "all other" category and should not be included in any of the figures used above.

Where is the polystyrene increase coming from? Almost no one seems willing to answer that question—"across the board" is the usual answer. An observer might say that it comes from "impact" but the figures above indicate that general purpose is holding its own. One of the interesting answers to this question comes from E. L. Kropcott of Dow Chemical, who, among other ideas, says that:

"Potentials in packaging are even greater than in appliances, which is now the largest; lighting, air conditioning, automobiles are practically untouched markets; development of a self-extinguishing material would make possible markets in construction—an outdoor weathering material would do likewise; controlled density products where only the necessary weight-strength is used would make substantial savings."

One of the interesting things about polystyrene is how it hangs on in fields where it is supposed to roll over and play dead because of competition from other plastics. Housewares and toys are good examples, where perhaps 40 and 60 million lb., respectively, are consumed, in addition to a huge amount of reprocessed material. Decorated, clear polystyrene tumblers, **(To page 45)**

Thomas Tann, Extruded Plastics Dept. Head, and D. S. Watkins, Vice-President Sales, Chardon Rubber Company, Chardon, Ohio

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Creating Progress Through Chemistry

Chemical Division GENERAL

THE PLASTISCOPE

(Continued from page 43)

for another, have been a hit at the Housewares Show for several years—the original molds are still running and many competitors have entered the field. The toy field, of course, has been benefited by the fad for "models" which use first grade and impact material. No doubt polystyrene would have been in larger volume in these fields without the advent of polyethylene, but even so, usage seems to increase from year to year.

The copolymers, too, are making steady progress as exemplified by the ABS telephone hand sets and various housings. ANS (acrylonitrile-styrene) materials which offer clarity, transparency, chemical resistance, and moderate strength are also on the way up. Look for extensive promotions in this line before long—producers have been intensifying their efforts to push this material and are confident it will pay off.

Extra-high impact styrene. The price on extra-high impact was reduced from 40¢ to 35¢ about three months ago. It is still higher than regular high impact at 28½, medium impact at 26½, and a lower impact at 25¢, but it is believed that the new price will open new markets.

Molders report that the new Bakelite 2100 will give the strength of ABS polymers and can be used where chemical resistance is not so critical, since it is considerably less costly per pound and has a lower specific gravity than ABS materials. Outstanding property of the new formulation is said to be great strength at low temperature. Furthermore, it can be easily processed in comparison with high impact. It is being particularly suggested for liners in refrigerated trucks, 10-mil-thick container lids, and anywhere else where brittleness at low temperature may handicap other materials.

Keep a lookout for Vexar. Du Pont's new plastic netting and piping, manufactured by a process that extrudes polymers directly in tubular net form through a single operation is beginning to go to market in various forms.

An example is a polyethylene net sack for onions. One reason is that it helps to delay sprouting, since there is no collection of moisture that takes place in a PE film bag or paper. PE also gets punctured and paper netting costs more than Vexar.

Potato sacks is another possibility—with a Vexar sack they can be packaged in the field and won't sprout so quickly in storage. Field packaging can also be done with citrus fruit since Vexar heightens the color of the fruit and does a real dress-up job.

Christmas tree bulbs or ornaments can be wrapped with Vexar in long strings and then draped around the tree in one long chain rather than attached individually.

A flat Vexar net sheeting is being used as a shelf liner for bars to permit fluids to drain off—the material is bought in rolls and cut to fit the desired space around spigots or elsewhere on a bar.

Industrial uses include an extruded tube for metal shafts where paper was formerly used. Paper tubes had to be carried in many sizes to fit the shaft, but Vexar tubes can be carried in three standard sizes up to ¼ in. diameter, and because of their flexibility can be stretched or fitted to various shaft sizes. **(To page 47)**

THE PLASTISCOPE

(Continued from page 45)

It has also been used as a "damp chaser" tube—a contriver that consists of an aluminum tube with a heater inside for closets and other enclosures. The netting prevents burned fingers and dresses up the appearance. A portable auto seat cushion with a covering Vexar net to protect the fiber or jute is now on the market. Filter cores for electroplating are less costly when made of Vexar. Beachwear, hats, hair curlers are other products adapted to use of this material, which is available at $1.50 a lb. in tubular or sheeting form.

Low-viscosity epoxy without odor. A new low-viscosity, epichlorohydrin and bishphenol-A type epoxy that does not incorporate the usual volatile diluents has been announced by Reichhold Chemicals. It is claimed to be the only low-viscosity epoxy resin of this type that is free from glycidyl ether fumes and thus is much easier to handle. It can be processed somewhat like high-viscosity resins, where masks are unnecessary. This resin, Epotuf E D-1025, can be cured at room temperature, whereas the epoxidized olefin type epoxies that don't contain glycidyl ether should be heat cured.

It is suggested by Reichhold for 1) electricals, where company technicians say it can be highly filled and give good water resistance and has the advantage of easy formulation because there is little or no odor; 2) for laminating, where low-viscosity resins are difficult to handle because of odor and possibly develop more widespread use of laminates for large boats; and 3) for floor surfacing where layers are over ⅛-in. thick and can be put down over a large area, whereas formerly only small areas could be put down at one time because of volatile odors.

Possible tight situation in plasticizers. The continued low production of steel means that there is likely to be another shortage of naphthalene. This means that phthalic anhydride, from which phthalate plasticizers are produced, is again likely to become tight. If steel production picks up before the end of August, there should be no particular problem since naphthalene will again be available, but if vinyl chloride consumption starts moving ahead before steel, the plasticizer position could tighten up to serious proportions. In fact, plasticizers have been on allocation by several producers for some months.

Vinyl chloride consumption dropped off to a considerable degree in April and June, and will probably be low in July and August, but is expected to resume on a big scale again in September when automotive and other industrials start upward. Despite heavy purchasing of phthalate plasticizers in June, before the pre-announced price rise on July 1, there is no large inventory on hand and consequently a large increase in vinyl chloride applications could create a further tightness in plasticizers that may not be completely relieved before November or December. The naphthalene shortage situation, which has created a problem in phthalic anhydride production several times in the past, will probably be eased in 1961, when several petroleum companies start producing ortho-xylene, which can also be used to make phthalic anhydride.

For additional and more detailed news see Section 2, starting on p. 202

NEW MACHINERY-EQUIPMENT

Specifications, claims made, and prices appearing in these pages are those of the manufacturers or sellers of the machinery and equipment described, or their agents.*

Blow molder

For the blow molding of large toys, housewares, industrial products, and containers, liners and drums to 30 gal. capacities, the 450 Series machines with four molding stations mold items to 14 in. in diameter and 48 in. long at dry cycle rates up to 6000 parts/hr. Two-station models mold pieces to 14 in. deep by 28 in. wide by 48 in. long. Designed for automatic, high speed operation, the machines handle 450 lb./hr. of plastic from continuously running 4½-in. extruders. Automatic molding operation and automatic part ejection permit use of conveyors for moving molded parts to other operations. Short runs, with frequent mold changes, are easily set up. The entire press section may be moved on rails from under the manifold for mold changeover. Platens are key slotted and tapped holes allow fast mounting of a variety of molds. Mounted on a base plate, the press can be moved and locked sideways, front to back and up and down to allow accurate alignment of molds and manifold die heads. Fast, shockless platen movement is hydraulically controlled, and accurate platen alignment is maintained by four tie bars. The manifold, designed for easy upkeep, is built to handle the large parisons. A rotary manifold valve feeds material to die stations with no material cut-off. Manifold passages, designed to eliminate material traps, have removable ends for cleanout and inspection. Heated torpedoes maintain correct material temperature while deflecting material to the molding stations. The machines utilize an efficient two-stage cycle, with only linear motion for peak efficiency. Blowing is normally done through the head; however, needle blowing is easily provided if required. Payment of royalties after purchase is not required. *Auto-Blow Corp., subsidiary of National Cleveland Corp., 409 Bishop Ave., Bridgeport, Conn.*

Web control unit

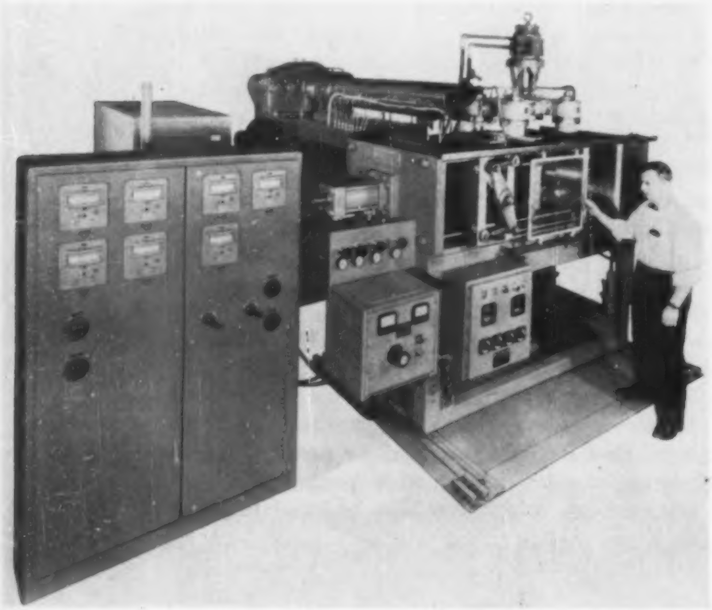
Clutch and brake units that lend themselves to tapered tension winding without resorting to cam or program modulation of flux in many winding jobs, can be used for winding of Teflon tape, polyethylene lay flat, or gusseted film, wire winding, cable haul off and take up, etc. The units are suitable for high- or low-speed operation, with easily adjustable tensions from near zero to several pounds per inch of web width, requiring torques up to 1800 and higher. To provide a uniformity of tensions, the unit increases output torque as speeds decrease. This natural characteristic produces tapered tensions which are desirable in many winding operations. The units also lend themselves to programmed torque control. *Web Controls Corp., 318 Briarcliffe Road, West Englewood, N. J.*

Sheet feeder

Overarm feeder can be used for feeding plastic sheets from a pile to processing or conveying equipment, or conversely, for piling sheets as they come from production. Sheets handled can range in size up to 6 by 20 feet. The feeder grasps sheets by means of vacuum cups supported on a carrier which is mounted between two oscillating arms. Typical production rate is 10 sheets/min. The unit is hydraulically operated, handles rectangular or irregularly shaped sheets, flat or formed sheets (corrugated for example), and can pick up or deliver sheets vertically as well as horizontally. It requires floor space only slightly larger than the sheets being handled, has no elevator, stacks sheets in piles up to 30 in. high, does not mark the sheets, and is easily serviced. *The de Florez Co. Inc., 200 Sylvan Ave., Englewood Cliffs, N. J.*

Static eliminator

Called the Aerostat, this new device incorporates a static neutralizer-head in the air outlet of a centrifugal blower and neutralizes static at distances of up to 4 ft. on materials subjected to the air stream. The ionized air which causes the static elimination is produced in the static neutralizer-head. Large plastic parts can now be effectively neutralized, since the air will travel beyond the range of an ordinary static bar. Molded pieces which require that both sides of the part be neutralized simultaneously can be treated, by placing a unit on either side of the part. Can also be used in tumbling and deflashing to help **(To page 50)**



AUTO-BLOW SERIES 450 blow molding machine, shown with four-head parison manifold, is designed to blow mold up to 30-gal. items.

* Prices are deemed to be F.O.B. sellers' plants (unless otherwise stated), are for "standard" models, and are subject to change without notice. The publishers and editors of MODERN PLASTICS do not warrant and do not assume any responsibility whatsoever for the correctness of the same, or otherwise.

NEW MACHINERY

(*From page 48*)

prevent dust attraction. The unit comes in two sizes, one having an effective length of 10 in. and a larger double unit having an effective length of 20 inches. For discharging large parts or wide materials, the units may be butted together to create a continuous neutralizing field of any width extending out from the ionizers to a depth of field of 4 feet. Both sizes are available with standard static neutralizer-heads (Types A-10 and A-20) or with "shockless" static neutralizer-heads (Types AS-10 and AS-20). A small power pack will operate a number of the devices. *The Simco Co., 920 Walnut St., Lansdale, Pa.*

Precision laminating press

Series 250 precision hydraulic presses were designed for holding extremely accurate laminating or molding tolerances over the entire platen area. Laminate layers will not slip upon initial platen contact because of platen guides that maintain accurate guiding under any temperature conditions. Press sizes range from 12 to 24 in. platens. Electrically or steam heated capacities range from 50 to 300 tons. Pumping controls may be manual, push-button, or semi-automatic, or as required. *Atlas Hydraulics Div., Delaware Valley Mfg. Co. Inc., 3576 Ruth St., Philadelphia 34, Pa.*

ATLAS Series 250 laminating presses have platens ranging from 12 to 24 inches.

Welding gun

Called the Allen-Universal Welding Gun, this electrically heated hot gas welder can be used with PVC, polyethylene, polypropylene, and other thermoplastics. The basic tool can be used for various welds using interchangeable tips and attachments. Heating is provided by extra heavy replaceable Ni-Chrome heating elements. Handle of the gun is air cooled. A control valve regulates the hot gas stream and prevents burning the work. Basic price of gun with 15-ft. wire and plug, $45.00. *Esto Mfg. Co. Inc., 1817 Highland St., Allentown, Pa.*

Production monitor

For use on plastic presses, this unit will monitor the time each machine is actually running on 10 different units. It can be used to determine what percentage of the shift was production time and what amount was idle time. It is readable within 1/10 min. or hour. The time data are essential where rates are to be established and where wages are based on machine use. *Gorrell & Gorrell, Westwood, N. J.*

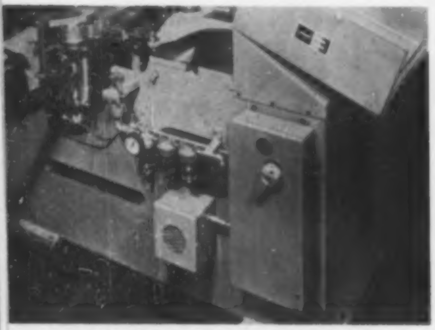
Punch press

A horizontal punch press, coupled with a specially-designed roll feed, has been developed to handle plastics sheet and light-gage metals at speeds of about 1500 strokes/min. The unit incorporates a vertical crankshaft with the flywheel and clutch in the base. The horizontal axis and low center of gravity com- **(To page 52)**

NEW MACHINERY-EQUIPMENT

(From page 50)

bine to give the press stability at the high speeds at which it operates. The unit measures 40 in. high by 25 in. deep by 54 in. overall length. The specially designed double roll feed



EMHART V&O horizontal punch press with protective cover open to show the double roll, rock driven, strip feeder (upper left).

is rack driven from a "walking beam" which, in turn, is driven by an eccentric from the top of the press shaft. It can handle material 6 in. wide and up to a 4-in. length of feed. *Emhart Mfg. Co., Hudson, N. Y.*

Foam machines

Fully automatic line of urethane foam machines is designed to produce a full range of polyether, polyester, dimer base, or halogenated hydrocarbon self-blown foams, either flexible, rigid, or semi-rigid in a full range of densities. Units are available in the following capacities: Model #100: 50-450 g./min.; Model #800: to 8 lb./min.; Model #1500: to 15 lb./min.; Model #2500: to 25 lb./min.; Model #5000: to 50 lb./min.; Model C: to 100 lb./min.; Model C50: to 150 lb./min. and Model C75: to 175 lb./min. Operation of unit is fully electronically controlled and includes as standard, automatic mixing head for predetermined fill of molds or for continuous operation. *Gabriel Williams Co. Inc., 77 Mill Rd., Freeport, N. Y.*

Unwind, rewind stands

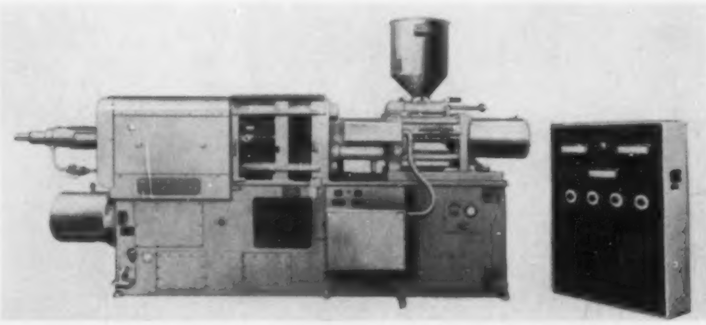
Model TO-24, a turret-type unwind stand, features a "flying splice" action that automatically and instantaneously splices a new roll of stock onto a moving web, without stopping or slowing down the process. Model TO-24R turret-type rewind stand, similarly transfers the moving web to a new core without stopping or slowing down the process. Heavy duty units, shaft or shaftless, accommodate 48-, 60- and 72-in. diameter rolls and operate at speeds of about 500 ft./min. Heavy-duty unwinds and rewinds have air-operated, water-cooled brakes and adjustable arms to accommodate various web stock widths. Constant tension and web guiding is available. Low-cost, light-duty unwinds incorporate manual braking and accurate side lay. Web guiding is optional. *Stanford Engineering Co., Salem, Ill.*

Injection machine

Especially suited for the production of thin-wall containers, Model 30.MS.30 Mark II injection molding machine is a fully-automatic recycling unit with 3-zone temperature control, double prime and feed, adjustable mold opening and *A* or *B* Thermax plasticating chamber. The machine can also be equipped with mold speed control and sensing, fast cycling equipment, nylon equipment, and air ejection that can be supplied as optional extras. *Peco Machinery Sales Ltd., 28 Victoria St., London SW1, England.*

Glossmeter

Hunterlab D36 Distinctness-of-Image Glossmeter is the first photoelectric instrument to measure the capacity of surfaces to reflect images. For measurements on plastics, laminates, and films, this instrument is sensitive to high-gloss differences not heretofore measurable. It differs from conventional glossmeters by using a revolving slotted disk in place of the usual stationary receptor window. Peak scale also measures **(To page 54)**



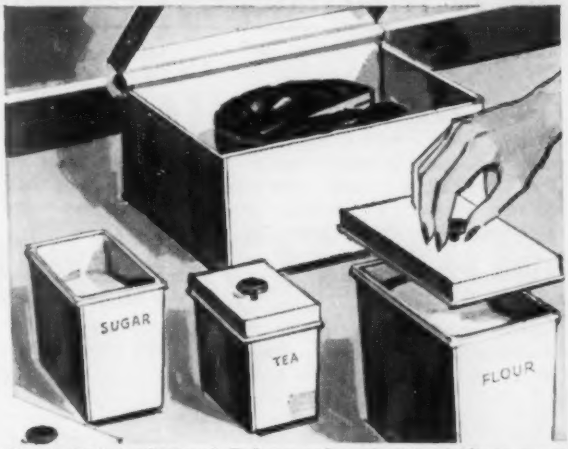
PECO Model 30.MS.30 Mark II injection molding machine has a three-zone temperature control, double prime and feed, adjustable mold opening, and A or B Thermax plasticating chamber.

Provisional specification: 30.MS.30 Mark II injection machine

	A plasticating unit	*B plasticating unit*
Weight molded per shot (polystyrene)		
Single feed, oz.	4½	6
Double feed, oz.	6½	8½
Volume molded per shot		
Single feed, cu. in.	7.4	9.8
Double feed, cu. in.	10.6	13.9
Capacity of feed hopper, lb.	65	65
Plasticating capacity, lb./hr.	90	90
Maximum pressure on material, p.s.i.	21,000	15,400
Full stroke of injection plunger, in.	10.37	10.37
Rate of injection, cu. in./sec.	7.5	10
Minimum dry cycle time, single feed, sec.	6	6
Size of platen, in.	25 by 23.5	25 by 23.5
Space between guides, in.	15.5 by 14	15.5 by 14
Mold opening stroke, in.	12	12
Maximum mold height, in.	12.75	12.75
Minimum mold height, in.	6	6
Mold locking force, tons	168	168
Projected molding area, sq. in.	60	82

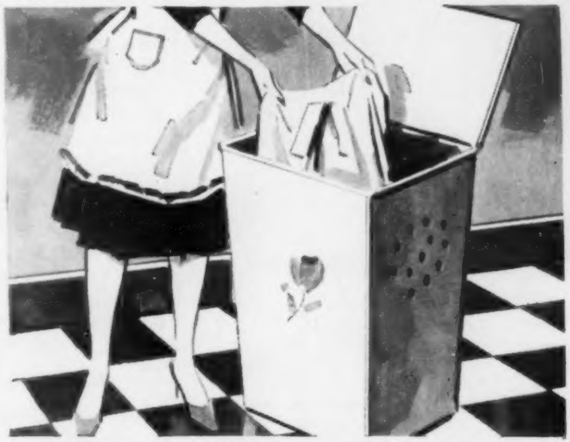
WHAT'S NEWS IN PLASTICS

Beats the Heat! Housewares made of Escon get repeated use without warpage. That's because the heat resistance of polypropylene is greater than any other polyolefin. This makes it the desired material for such items as colanders, drainboards, dishpans, tumblers and lighting grilles.



Fresh Point of View! Polypropylene is 2 to 4 times more impermeable to gases and liquids than other thermoplastics. This means freshness stays in, outside elements can't enter. This makes Escon ideal for canister sets, bread boxes and cookie jars—which can be snap-fitted or self-hinged.

Cool Item! Escon is excellent as a food crisper for several reasons. It won't absorb strong food odors and, when properly molded, has the ability to take normal cold without cracking. The design possibilities with versatile Escon are limitless, providing the opportunity to expand existing markets.



New Idea! Escon can be undercut at high speed production cycles. Such items as clothes hampers can be molded in single flat pieces of various colors, then snap-locked for assembly and hinging. This means manufacturers can ship more products in less space... retailers will use less storage space, too.

Escon® POLYPROPYLENE

Important news for molders and designers...

Escon polypropylene is here! It's the amazing thermoplastic ideally suited to your product needs.

Versatile Escon is easy to work with! It can be injection and compression molded, extruded, thermoformed and heat sealed. Because of its low density, this amazing thermoplastic resin yields more pieces per pound.

For the designer, the high strength of Escon plus its excellent chemical and abrasion resistance allows accurate production of fine and intricate designs with high surface gloss.

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ENJAY
PLASTICS

NEW MACHINERY-EQUIPMENT

(*From page 52*)

specular gloss with higher angular resolving power and greater tolerance for specimen nonflatness than has heretofore been possible. *Hunter Assocs. Laboratory Inc., 5421 Brier Ridge Rd., McLean, Va.*

Compounding extruder

A combination of double screw extruder and internal mixer, this electrically heated, air cooled, Model DSM II/150 machine is de-

KARAUSS-MAFFEI unit is combination of double screw extruder and internal mixer.

signed for the compounding of plastic material (coloring and blending). The feed section is equipped with conventional screws. This is followed by a mixing section which is equipped with spade shaped kneading disks and then a final screw section. Significant specifications are shown below:

Approx. screw diameter, in.	
Feed area	11.8
Kneader area	11.8
Extrusion area	5.9
Screw speed ranges,	
r.p.m.	65 to 22
	44 to 15
Typical compounding rates	
Low pressure PE	1072 lb./hr.
Rigid PVC	1072 lb./hr.
Elastomeric PVC	2420 lb./hr.

Krauss-Maffei, Aktiengesellschaft, Munich-Allach, Germany.

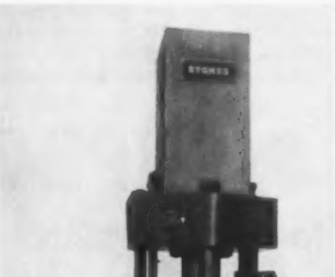
Insert transfer press

Especially adaptable to insert molding, this series of Model 744 transfer-compression presses incorporates a unique, rotary, stationary platen which reduces press idle time needed for insert loading to a minimum. Two stations on the indexing rotary table carry identical halves of the mold while the mating half of the rotating mold is mounted on the movable clamp ram of the machine. While one of the lower mold halves is in the normal molding position in the press for pressing and curing, the other lower mold half is outside the press easily accessible for insert loading. While a shot is curing the operator is loading the next shot and idle time is minimized. Initial models of the press have a 150-ton clamp. Both larger and smaller sizes are available. Specifications of the 150-ton model are shown below. *F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.*

Specifications: Model 744 transfer compression press

Clamp force, tons	150
Clamp stroke, max., in.[a]	14
Daylight, press open, in.	31
press closed, in.	17
Platen area[b], in.	22 by 16
Clamp ram speeds:	
Closing, in./min.	400
Intermediate, in./min.	72
Pressing, in./min.[a]	0 to 22
Opening, in./min.	400
Bottom ejection stroke, in.	6
Ejection press, tons	13
Bottom transfer force, tons	30
Bottom transfer stroke, in.	6
Bottom transfer speeds:	
Advance, in./min.	360
Pressing, in./min.[a]	0 to 100
Return, in./min.	300

[a]Adjustable. [b]Left to right—front to back.



Marker

For code marking plastic parts, this small air operated unit places letters, numbers, or other markings on items that require an "unnoticeable" identification marking *after* manufacture. Unit operates cold (not a hot stamper). It includes an interchangeable die holder and fixed holder for product being marked. Size is approximately 6 in. wide by 12 in. high by 10 in. deep, for mounting singly or in series on a work bench. *The AcroMark Co., 5-15 Morrell St., Elizabeth, N. J.*

Pyrometer

The Thermi-Tem can be used to measure temperature of liquids, penetrable masses, and surfaces such as plastic stock and mold temperatures. Temperature is measured in 3 to 10 sec. with an accuracy of 2 percent. Linear temperature scales are available as low as −50° F. or as high as 500° F. The probe has a 6-ft. lead and can either be straight or have a 90° angle. *Testing Machines Inc., Mineola, N. Y.*

Versatile extruder with interchangeable gears

Designated as the Prodex H T (high torque) line, this series of plastics extruders is designed to deliver the highest possible production rate from any given size extruder. Key to this performance are the gear transmissions used on the machines. These are equipped with a set of various change gears to permit selection of the optimum reduction ratio and screw speed to suit any extrusion job. Using these interchangeable gears, as much torque as is desired can be developed, and the only limitation is the amount of torque that the screw being used can handle without breakdown. By providing the maximum possible output from a given motor horsepower input, a single machine can efficiently extrude most all materials without making a major change in the motor drive. The shank of the screws used in these new extruders as well as the thrust bearings, have been redesigned to handle the heaviest torque loadings. Also novel in the design is a new seal on the screw shank, which avoids the leakage of powders and permits the easy installation of vacuum hoppers. **(To page 56)**


NEW NEW NEW NEW DUPLIMATIC
BLOWMOLDER
Here is production "magic" in the manufacture of plastic bottles, jars and parts with irregular shapes. The Model 1246 ELIMINATES SECONDARY OPERATIONS! "Pinch-off" is eliminated and sections through the bottom and throughout the bottle are much more uniform than those produced by extrusion methods.
Write . . . wire or phone for complete information . . . number of machines available is limited . . .
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MOSLO MACHINERY COMPANY
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Manufacturers of the World's Finest Plastic Injection

NEW MACHINERY-EQUIPMENT

(From page 54)

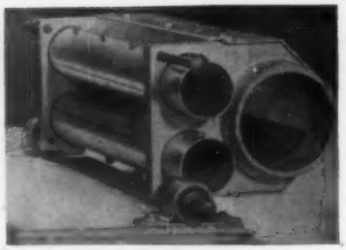
The seal can be changed in minutes without removing the screw from the machine. Change gear type extruders with the following screw sizes and respective horsepower ranges are available: 2½ in. (20 to 40 h.p.); 3½ in. (40 to 100 h.p.); 4½ in. (60 to 150 h.p.); 6 in. (125 to 200 h.p.); 8 in. (200 to 400 h.p.); 10 in. (300 to 700 hp.). All sizes can be supplied with L/D ratios of 20:1, 24:1, and 30:1, in either single- or multiple-stage vented models. To illustrate the advantages of the new change gear transmission, the following examples are helpful: 1) A 2½ in. H T extruder with a 25-h.p. Dynamatic drive and gearing for 200 r.p.m. speed, readily delivers 250 lb./hr. of plasticized PVC. For rigid PVC, change gears for 120 r.p.m. maximum screw speed are used to produce 150 lb./hr. at 80 r.p.m. Without the change gear provision, a 40-h.p. motor would have been necessary to provide adequate torque for the rigid PVC. Consequently, there would be a higher initial cost, together with a severe waste of power under all conditions. 2) Using the 4½ in. H T extruder, equipped with a 75-h.p. Dynamatic drive and gearing for 90 r.p.m. maximum screw speed, turns out 650 lb./hr. of high-impact polystyrene without predrying. In order to run polypropylene (M.IO.2), change gears for 65 r.p.m. maximum speed are used to deliver about 500 lb./hr. of this material. Without change gears, this machine would need a 125-h.p. drive, which would result in a substantial horsepower waste. *Prodex Corp., Fords, N. J.*

Foam machine

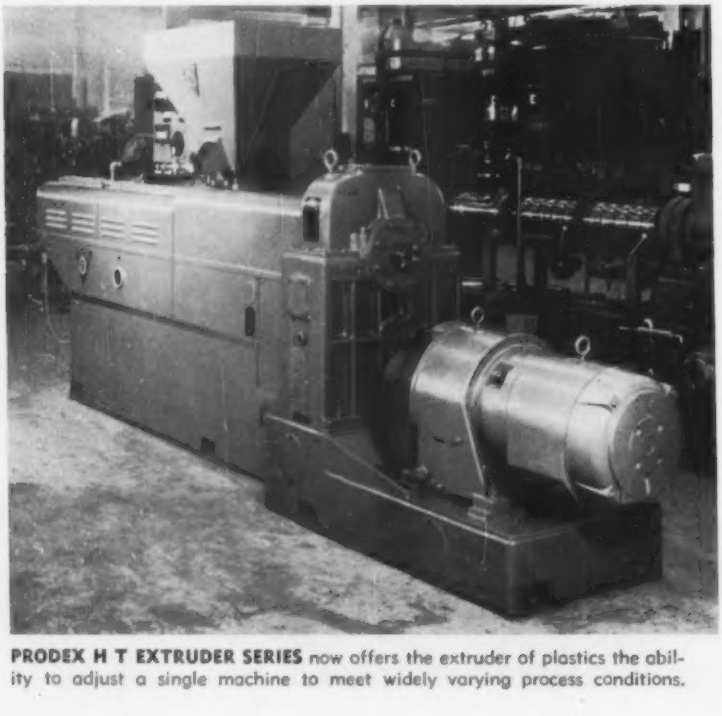
The miniature model small-shot production polyurethane foam machine is capable of pumping, metering, and mixing two-component formulations for rigid, semi-rigid, or flexible foams. Throughput is variable from 0 to 2 lb./min. With the self-cleaning, on-off mixing device, shots of mixed materials can be accurately proportioned, dispensed, and reproduced in quantities of a few grams to continuous pours. The unit is self-contained and includes component tanks; temperature controlling heat exchangers and heated delivery hoses; individual throughput control of materials by positive type variable drives and rotary pumps; and mixing head and foam cycle controls. Dimensions are 33 by 26 by 52 inches. *Martin Sweets Co. Inc., 114 S. First St., Louisville, Ky.*

Web coating dryer

Called the Double Air Jet, this device (patent applied for) can be used in processing webs in plastic coating operations involving the removal of volatiles from the web. The unit impinges two opposing preheated air streams at an adjustable angle against the moving web through two slots in the tubular air input chambers. After the volatiles are swept from the surface of the web by the jets, the volatile-laden air passes out through the tubular air outlet chamber. The unit uses 30 cu. ft./min. of air per 10 in. of unit length and web width, and is three to four times as efficient as commonly used dryers. It can be fitted to the machine by four bolts and swings freely away on two bearings for cleaning of the slots and threading of the web. Dimensions: 4 in. deep, 5 in. high, length according to width of web. It is made of lightweight aluminum, weighing only 2½ lb. per 10 in. of unit. *Comac Engineering Inc., 239 Mill St., Byram, Conn.*



COMAC Double Air Jet web drying and cooling device on its side showing air slots.



PRODEX H T EXTRUDER SERIES now offers the extruder of plastics the ability to adjust a single machine to meet widely varying process conditions.

. . . Machinery in brief

▶ Magnetic drives, in ratings from 75 to 4000 hp., have simplified design with few moving parts and provide versatile adjustable speed performance over an automatically regulated 20:1 range. *The Louis Allis Co., 427 E. Stewart St., Milwaukee 1, Wis.*

▶ A portable bench-size tumbling machine, Model RA4 Rollabrader, is intended for small-parts work. The machine processes four barrels at one time and has 20- to 46-rpm. variable speed drive. Barrels are each 2-qt. capacity, with orange No-Seam vinyl lining. *Rampe Mfg. Co., 14915 Woodworth Ave., Cleveland 10, Ohio.*

▶ Bolted type replacement heating cylinders specially designed for vinyl molding or where easy dismantling for cleaning is necessary. Models can be adapted to any make or model of injection press. Many designs are stock items. *Injection Molders Supply Co., 3514 Lee Road, Cleveland, Ohio.*—**End**

Embossing press converted to electric heat.

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Genesee 3-0821
DES MOINES, IOWA
Cherry 3-1203
DETROIT, MICH.
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HOUSTON, TEX.
Capitol 5-0356
INDIANAPOLIS, IND.
Melrose 5-5313
KANSAS CITY, MO.
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Diamond 6-9606
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Broadway 1-3021
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Federal 6-6631
NASHVILLE, TENN.
Cypress 2-7016
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(See Bloomfield, N.J.)
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Amherst 2-5647

WORLD-WIDE PLASTICS DIGEST*

Abstracts from the world's literature relative to plastics. For complete articles, send requests direct to publishers. List of addresses is at end of this section.

General

Photopolymers start their move to market. Chem. Week 86, 35-36, 38-40 (Apr. 1960). Photosensitive polymers include polyvinyl alcohol, plastics films containing photoactive chemicals, polyvinyl chloride, and polyamide interpolymers. The processes and applications are discussed.

Polypropylene film challenges cellophane. Chem. Eng. News 38, 55 (May 2, 1960). Polypropylene film can be biaxially-oriented to improve its strength and coated to make it heat-sealable. It has low water vapor transmission rate.

Soluble films brighten PVA sales prospects. Chem. Week 86, 89-90, 93 (May 7, 1960). Applications and potential sales of water-soluble polyvinyl alcohol films for use in packaging are considered.

3M makes fluorocarbon rubber. Chem. Eng. News 38, 107 (Apr. 18, 1960). The copolymer of trifluoronitrosomethane and tetrafluoroethylene has elastomeric properties.

Cyanoethylation makes electrical magic. Chem. Week 86, 103-04 (May 28, 1960). Cyanoethylated cellulose has the ability to hold electricity and release it with conversion to heat. It is soluble in organic solvents and can be molded at a temperature of 200° C. and 6000 p.s.i.

New epoxies. S. A. Miller. Materials in Design Eng. 51, 17-20, 189-92 (Apr. 1960). Mechanical, electrical, and processing properties of new epoxy resins are given.

Tomorrow's epoxy market. C. P. Waite. Adhesives Age 3, 32-35 (Mar. 1960). A survey indicates that epoxy adhesives have a good economic growth potential.

Materials

Resistance to thermal embrittlement and hydrolysis improved with isocyanate treatment for Mylar polyester film. M. M. Lee and R. D. Hodges. Insulation 5, 18-26 (Oct. 1959). The "liquid bath" and the "vapor phase" processes for treating Mylar film with isocyanates are described. These treatments on Mylar films increase its resistance to thermal embrittlement, hydrolysis, and deterioration of mechanical properties when subjected to elevated temperatures. The degree of improvement depends on the treating conditions, the thickness of the film, as well as the temperature at which the treated films are to be aged.

Preparation and properties of graft polymers. M. Magat. Kunststoffe 50, 57-59 (Jan. 1960). Problems concerned with applications as well as technology of graft polymers are discussed and surveyed.

Epoxy resins. Ind. Eng. Chem. 52, 317-26 (Apr. 1960). Seven articles on epoxy resins are presented covering the subjects of "Forecasting Epoxy Resin Markets," by J. R. Willner; "Coatings from Cyclohexene Oxide Derivatives," by C. W. McGary Jr., C. T. Patrick Jr., and R. Stickle Jr.; "An Epoxy Resin from Phenolphthalein," by E. S. Lo;" "Polyesters from Epoxides and Anhydrides," by R. F. Fischer; "Epoxy Resin Systems Based on Epoxidized Soybean Oil and HET Anhydride," by C. S. Illardo and B. O. Schoepfle; "Epoxy Resins from Resorcinol-Acetone Condensation Products," by C. L. Segal and J. B. Rust; and "Glycidyl Ether Reactivities in Varnishes from Liquid Epoxy Resins," by J. Wynstra, R. P. Kurkjy, and N. H. Reinking.

Terylene polyester fiber as a resin reinforcement. Plastics Progress in India 2, 15-18 (Feb. 1960). Test data are presented which show that glass fiber plastic laminates faced with overlays of Terylene fiber are superior in wet strength and resistance to acids to those reinforced with glass fibers alone.

Heat-resistant encapsulating resins. M. M. Lee and R. D. Hodges. Plastics Tech. 6, 43-48, 50 (Apr. 1960). The heat distortion temperatures, weight losses, and electrical properties of some polyester, epoxy, silicone, and polybutadiene encapsulating resins are reported.

Epoxy plastics. J. W. Bryan and R. A. Perkins. Univ. California Radiation Lab. Report No. 9020, 13 pp. (Dec. 24, 1959). Practical methods of handling and using some of the many epoxy plastics are described. Molds, mold-release agents, fillers, diluents, and modifiers are discussed. Mixing, pumping, bonding, equipment required, and toxicity are also covered. A collection of formulae is given in table form. The table makes it possible to select the appropriate type of epoxy mixture for the specific job. Available from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.; price: 50 cents.

Fibrous silicone rubber. R. A. Russell. Ind. Eng. Chem. 52, 405-08 (May 1960). A fibrous matting of expanded silicone rubber consists of random, weblike arrangement of hollow filaments made by a spray process. The compression-set resistance and porosity is better than that of cellular elastomers. Properties and possible applications are considered.

Organotin monomers and polymers. D. A. Kochkin, V. N. Kotrelev, S. P. Kalinina, G. I. Kuznetsova, L. V. Laine, L. V. Cherbova, A. I. Borisova, and V. V. Borisenko. Vysokomolekuliarnye Soedineniia 1, 1507-13 (Oct. 1959). The synthesis of organotin monomers containing various radicals (methyl, propyl, n-butyl, isobutyl, isoamyl, hexyl, heptyl, octyl, and phenyl is described. Curves characterizing the thermomechanical properties of the polymers and copolymers are given.

Molding and fabricating

Two new machines for the production of deep drawn plastics packages. E. Escales. Kunststoffe 50, 219-20 (Apr. 1960). Two new machines for the continuous production of three dimensional, semi-rigid packages, drinking cups, and similar articles are described.

Cast steel molds for plastics processing. V. von Reimer. Kunststoffe 50, 195-97 (Mar. 1960). The advantages of pre-casting molds for plastics processing, especially those of cast steel, and the limitations of such a process are discussed.

Galvanoplastically produced hard nickel molds for plastics processing. P. Spiro. Kunststoffe 50, 191-94 (Mar. 1960). The manufacture of hard nickel molds by galvanoplastic methods is one of a number of ways of reducing **(To page 181)**

*Reg. U. S. Pat. Off.

U.S. PLASTICS PATENTS

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 25¢ each.

U.S. Pats., Apr. 19, 1960

Plastic welding. F. H. Mueller (to Mueller). 2,933,428.

Ion-exchange fibers. G. A. Richter Jr., C. H. McBurney, and B. B. Kine (to Rohm & Haas). 2,933,460.

Expanded phenolic resin. G. A. Mullen (to Westinghouse). 2,933,461.

Foamed polyurethanes. J. R. Fischer (to Aerojet). 2,933,462.

Stabilized polyvinyl chloride. H. M. Olson (to Harshaw). 2,933,465.

Polyurethanes. F. Hostettler (to Union Carbide). 2,933,477-8.

Addition polymers. C. H. McBurney, G. A. Richter Jr., and B. B. Kine (to Rohm & Haas). 2,933,479.

Interpolymers of mono- and diolefins. W. F. Gresham and M. Hunt (to Du Pont). 2,933,480.

Hexafluoropropene-vinylidene fluoride copolymer. J. S. Rugg (to Du Pont). 2,933,481.

Polypropylene. G. B. Stampa and A. G. Farnham (to Union Carbide). 2,933,482.

Polyolefin treatment. G. A. Klumb Jr. and C. E. Speer (to Dow). 2,933,484.

Inhibited pyrolysis of fluorocarbon polymers. L. A. Wall and J. D. Michaelson (to U. S.). 2,933,536.

U.S. Pats., Apr. 26, 1960

Apparatus for stretching plastic. P. Startzell (to Pittsburgh Plate). 2,933,759.

Plastic metering. J. A. Alesi. 2,933,-763.

Carbamide resin foam. O. A. Vieli and D. Klenk (to Cogepa). 2,933,767.

Extrusion onto a mandrel. H. F. Fisher (to Resistoflex). 2,933,769.

Processing films. R. Sardeson and C. Miller (to Pako). 2,934,000.

Alkylene oxide polymers. A. E. Gurgiolo (to Dow). 2,934,505.

Epoxide resins. D. D. Hicks, J. E. Masters, and W. J. Belanger (to Devoe & Raynolds). 2,934,506.

Polyvinyl chloride resins. D. H. Chadwick and T. Reetz (to Monsanto). 2,934,507.

Resins. B. Phillips, C. W. McGary, Jr. and C. T. Patrick Jr. (to Union Carbide). 2,934,508.

Phenolic soil conditioner. V. Auerbach and C. L. Tatton (to Union Carbide). 2,934,511.

Polyesters. D. D. Hicks and J. E. Masters (to Devoe & Raynolds). 2,934,513.

Blends of vinylidene chlorofluoride and ethylene-vinylene carbonate. I. O. Saylor and J. D. Calfee (to Monsanto). 2,934,514.

Polytetrafluoroethylene - silicone compositions. G. M. Konkle and T. D. Talcott (to Dow Corning). 2,934,515.

Carboxy-copolymer epoxide. D. D. Hicks (to Devoe & Raynolds). 2,934,-516.

Polycaproamide. D. W. Young (to Sinclair). 2,934,517.

Polyethylene oxide. K. L. Smith (to Union Carbide). 2,934,518.

Epoxy resin. G. Mayurnik (to Aries). 2,934,520.

Epoxide resin. J. E. Masters, D. D. Hicks, and W. J. Belanger (to Devoe & Raynolds). 2,934,521.

Phenolic resin-styrene ethers. A. M. Partansky and P. G. Schrader (to Dow). 2,934,522.

Dicyandiamide-formaldehyde. O. Albrecht and A. Hiestand (to Ciba). 2,934,523.

Acrylic copolymers. V. A. Phelps and H. H. Weinstock (to Allied Chemical). 2,934,524.

Acrylyloxy triazines. F. Fekete (to Pittsburgh Plate). 2,934,525.

Polyvinylphenyl boroxole. A. K. Hoffman and W. M. Thomas (to American Cyanamid). 2,934,526.

Propylene-bicyclohexene copolymer. G. R. McKay and P. H. Settlage (to Du Pont). 2,934,527.

Acrylamide polymers. L. A. Lundberg (to American Cyanamid). 2,934,528.

Polyvinyl chloride. C. P. van Dijk, F. J. F. van der Plas, and A. de Keizer (to Shell). 2,934,529.

U.S. Pats., May 3, 1960

Curved panels. B. Shwayder (to Shwayder Bros.). 2,934,790.

Lightweight molded nylon jacket. F. A. Harrington (to Marco). 2,934,792.

Nozzle for plastic tubing. W. F. Steinen. 2,935,341.

Plasticized thermoplastic. J. Linsk (to Standard Oil). 2,935,415.

Epoxide composition. B. Phillips, P. S. Starcher, C. W. McGary Jr., and C. T. Patrick Jr. (to Union Carbide). 2,935,488.

Vinylidene chloride polymer. C. B. Havens, A. J. Mason, and A. T. Widiger (to Dow). 2,935,490.

Vinyl resin stabilizer. G. P. Mack (to Metal and Thermit). 2,935,491.

Curing epoxy materials. H. A. Newey (to Shell). 2,935,492.

Formaldehyde - acrylamide - betaine reaction product. W. H. Schuller and W. M. Thomas (to American Cyanamid). 2,935,493.

Cyclic carbonate polymers. J. M. Whelan Jr. and W. P. Samuels Jr. (to Union Carbide). 2,935,494.

Low pressure olefins. H. Weber, H. Strache, F. Broich, W. Franke, and K. Kiepert (to Chemische Werke Huls). 2,935,501.

U.S. Pats., May 10, 1960

Molded sponge plastic. R. E. Walter and T. R. Graham (to Gerber). 2,935,762.

Blowing plastic bottles. R. B. Mason (to Plax). 2,935,764.

Reinforced plastic heel. F. M. Ronci. 2,935,799-800.

Metal-reinforced plastic gun barrel. J. L. Wilson (to Olin-Mathieson). 2,935,913.

Heat-resistant laminates. G. Alexander (to General Electric). 2,936,-260.

Sealing irradiated polyethylene. Q. P. Cole (to General Electric). 2,936,261.

Irradiating polymers. J. Rehner Jr. and W. J. Gilbert (to Esso). 2,936,271.

Halogenated diepoxides. C. W. McGary Jr. and C. T. Patrick Jr. (to Union Carbide). 2,936,292.

Polyisocyanates. G. O. Orth Jr. (to 3M) 2,936,293.—End

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Experimentation is the fountainhead of progress in both industry and the arts. At Westchester new thermoplastic colors are constantly formulated in the laboratory . . . where, as with all of our products, they are evaluated for uniform dispersion, desirable temperature and flow characteristics, and resistance to degrading and migrating. During the past 14 years we have created more than 4000 standard and unusual colors . . . establishing our concentrates and pre-mixed blends as the criteria of color quality.

Write now for detailed information on any color problem involving linear and conventional polyethylenes, polypropylenes, and other thermoplastics.

APPROVED FOR FOOD, DRUG AND COSMETIC PACKAGING

A new series of FDA certified WESTCHESTER colors is now available. These colors are supplied with a registration number, attesting FDA approval of the pigments.

WESTCHESTER PLASTICS

*WESTCHESTER PLASTICS, Inc.

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Custom Compounders of Polyethylene Molding Powder and other Thermoplastic Materials

Manufacturer and Developers of Unicolor and Formacolor *Pliothene, Formacolor, Unicolor® T.M. Reg. U.S. Pat. Off.

ESCAMBIA PVC RESINS

Escambia offers a complete line of outstanding PVC resins, including the following major categories:

ESCAMBIA PVC PEARLS* — Large, uniform particle size and *complete* freedom from fines characterizes this radically new type of homopolymer, which offers unusual processing advantages for certain applications.

ESCAMBIA DRY BLEND PVC RESINS — Escambia has pioneered in the development of money-saving dry blends and dry blend production techniques which produce both rigid and flexible items of superior quality at a substantial savings to the processor.

ESCAMBIA GENERAL PURPOSE PVC RESINS — Available in a wide range of molecular weights (including the new, very low molecular weight resins with superior flow characteristics), this series offers you many profitable advantages.

ESCAMBIA ELECTRICAL GRADE PVC RESINS — FOUR UL-approved Electrical Grade resins in this series give you a full range of molecular weights to fit any type of electrical application.

INCREASE YOUR PROFITS WITH THESE SUPERIOR QUALITY ESCAMBIA PVC RESINS

	1000 SERIES				
PHYSICAL PROPERTIES OF RESIN	1250*	1225*	1200*	1185*	1160
Average Relative Viscosity (1% Solution Cyclohexanone at 25°C)	2.40	2.25	2.03	1.85	1.60
Specific Gravity	1.40	1.40	1.40	1.40	1.40
Average Bulk Density (lbs./Cu. ft.)	31.5	33.5	35.0	39.0	41.0
Particle Size (Wet Screen Analysis) Through 40 Mesh Screen	100%	100%	100%	100%	100%
Oil Absorption, Minimum (M1-DOP/g of Resin based on ASTM Method)	—	—	—	—	—
Form	White Powder	White Powder	White Powder	White Powder	White Powder
PHYSICAL PROPERTIES OF COMPOUND (100 Parts Resin — 50 Parts DOP)					
Tensile Strength (PSI)	2960	2750	2670	2140	1420
100% Modulus (PSI)	1940	1920	1870	1350	1160
Ultimate Elongation (%)	340	300	280	270	166
Shore A Hardness	88±3	86±3	83±3	80±3	79±3

	2000 SERIES					
PHYSICAL PROPERTIES OF RESIN	2250	2225	2200	2185	2160	2150
Average Relative Viscosity (1% Solution Cyclohexanone at 25°C)	2.40	2.25	2.03	1.85	1.60	1.50
Specific Gravity	1.40	1.40	1.40	1.40	1.40	1.40
Average Bulk Density (lbs./Cu. ft.)	29	32	33.5	35	39	35
Particle Size (Wet Screen Analysis) Through 20 Mesh Screen	100%	100%	100%	100%	100%	100%
Oil Absorption, Minimum (M1-DOP/g of Resin based on ASTM Method)	—	—	—	—	—	—
Form	White Beads	White Beads	White Beads	White Beads	White Beads	White Beads
PHYSICAL PROPERTIES OF COMPOUND (100 Parts Resin — 50 Parts DOP)						
Tensile Strength (PSI)	2820	2820	2500	2190	1550	1400
100% Modulus (PSI)	1790	1540	1500	1400	1240	1150
Ultimate Elongation (%)	350	400	400	390	167	150
Shore A Hardness	86±3	84±3	82±3	83±3	79±3	77±3

	3000 SERIES				
PHYSICAL PROPERTIES OF RESIN	3250	3225	3200	3185	3160
Average Relative Viscosity (1% Solution Cyclohexanone at 25°C)	2.40	2.25	2.03	1.85	1.60
Specific Gravity	1.40	1.40	1.40	1.40	1.40
Average Bulk Density (lbs./Cu. ft.)	26	27	24	23	22
Particle Size (Wet Screen Analysis) Through 20 Mesh Screen	100%	100%	100%	100%	100%
Oil Absorption, Minimum (M1-DOP/g of Resin based on ASTM Method)	1.25	1.25	1.25	1.25	1.25
Form	White Beads	White Beads	White Beads	White Beads	White Beads
PHYSICAL PROPERTIES OF COMPOUND (100 Parts Resin — 50 Parts DOP)					
Tensile Strength (PSI)	2890	2790	2630	2170	1570
100% Modulus (PSI)	1860	1730	1690	1370	1220
Ultimate Elongation (%)	345	375	380	390	180
Shore A Hardness	87±3	86±3	84±3	80±3	79±3

*These resins available in UL-approved Electrical Grades.

PHYSICAL PROPERTIES OF UNPLASTICIZED RESIN — 2000 SERIES (Press Polished Sheets)

	2250	2225	2200	2185	2160	2150
RELATIVE VISCOSITY	2.40	2.25	2.03	1.85	1.60	1.50
ROCKWELL HARDNESS (ASTM D-785-51 Method A)						
R-Scale	118	117	117	117	118	117
M-Scale	61	61	61	61	61	60
IZOD IMPACT (NOTCHED) (ASTM 256-56 Method A) Ft. Lbs./inch Notch	0.8	0.8	0.6	0.33	0.25	0.20
HEAT DISTORTION (ASTM D-648-56)						
264 PSI °C	74	74	73	72	69.5	71.5
264 PSI °F	165	165	163.4	161.6	157.1	158.9
66 PSI °C	85	85	83.5	82.5	80.0	80.5
66 PSI °F	185	185	182.3	180.5	176.0	176.9
TENSILE STRENGTH (ASTM D-638-58T) PSI	8050	8350	8320	8500	6650	5000
MODULUS OF ELASTICITY FLEXURAL (x 10^5) (ASTM D-790-58T)	5.00	4.95	4.93	4.96	5.03	5.10
STRESS AT YIELD (ASTM D-790-58T) (PSI-Flexure)	14000	14200	13900	13700	7100	5500

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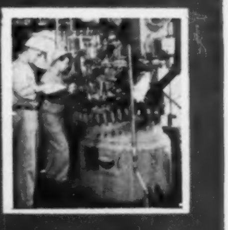

Escambia's Research Center, located at Wilton, Conn., ranks among the most modern and best equipped in the industry. Escambia's technical staff is available to help its customers develop profitable improvements in products and processes.

For more detailed information on Escambia resins, research facilities, or technical services, contact Department M

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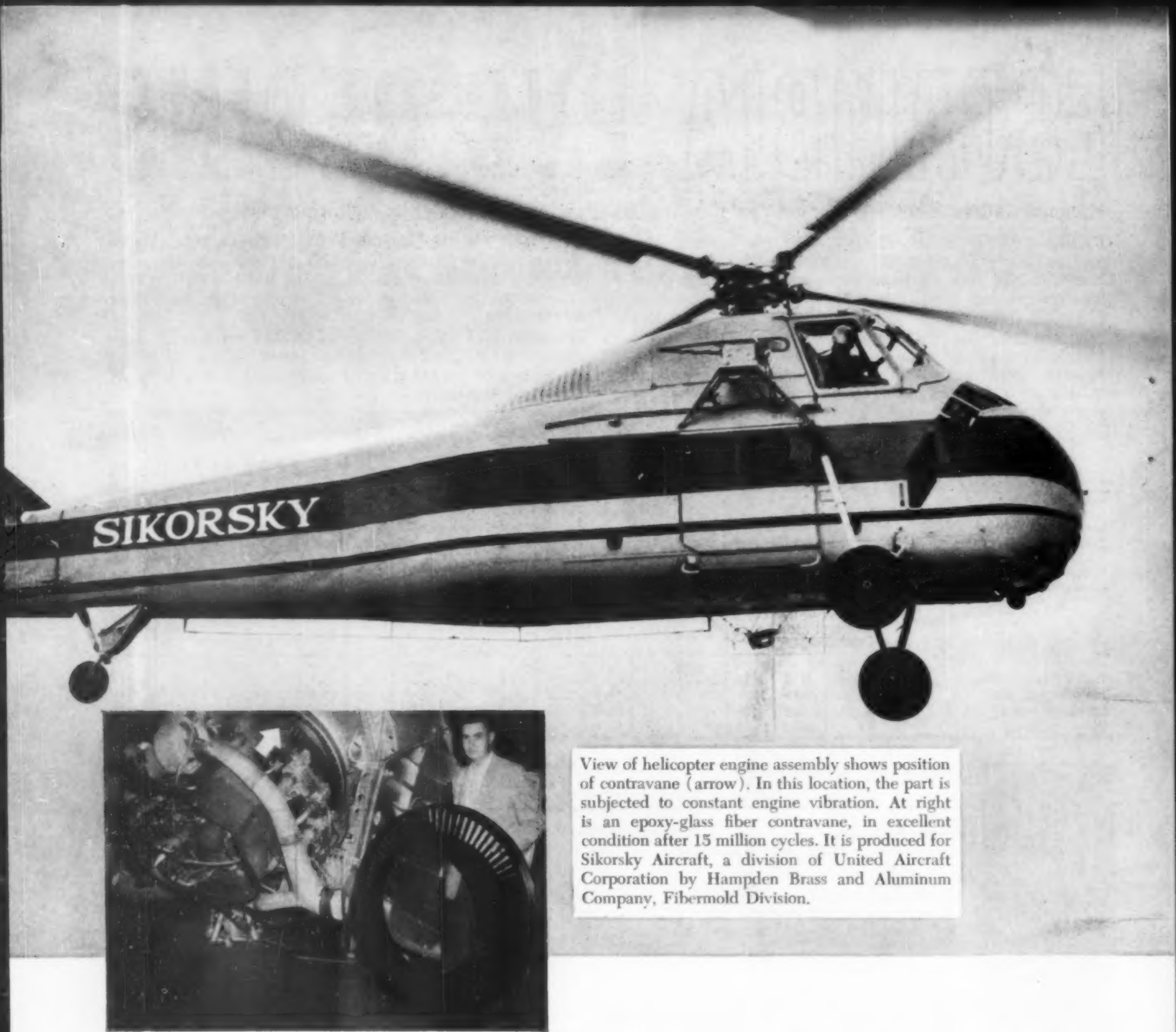


View of helicopter engine assembly shows position of contravane (arrow). In this location, the part is subjected to constant engine vibration. At right is an epoxy-glass fiber contravane, in excellent condition after 15 million cycles. It is produced for Sikorsky Aircraft, a division of United Aircraft Corporation by Hampden Brass and Aluminum Company, Fibermold Division.

U.S.I. POLYETHYLENE NEWS

A series of advertisements for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

Packaging Notes

Polyethylene handles for multi-trip refillable milk bottles as well as one-trip carriers for multi-unit packs of cans, bottles or jars, are now on the market.

Milk bottle handle

The milk bottle handles make half-gallon and gallon bottles easier and safer to carry and use.

Multi-unit one-trip carrier

The molded polyethylene multi-unit carriers, which can be used for beer cans, soft drink bottles and various grocery and household products, have a number of advantages over conventional carriers. Those cited for beer cans, for example: savings of 1 cent per six-pack; high-speed application of carriers—up to 1200 cans per minute; faster cooling when refrigerated; instantaneous product identification; quick stacking; containers easily removed; carrier unaffected by moisture; carrier easily discarded.

Polyethylene drum liners on a roll—heat-sealed at intervals and perforated just above the seal—have increased speed of lining corrugated cartons and drums threefold for one manufacturer. In the past, static electricity made the mouths of individual bags difficult to open; now, the tearing off action opens liners automatically. Photo shows workman pulling liner over mandril with one hand, while tearing it off roll overhead with the other. He'll simply flip both into drum, "cuff" the liner and remove the mandril.

Photo courtesy Bemis Bro. Bag Co.

Polyethylene bags in roll form have recently been introduced which will provide housewives with convenient containers for storing foods and other household items.

The prefabricated bags are packaged 25 to a roll in cartons similar to those used for waxed paper.

U.S.I. Introduces New PETROTHENE® Resin for Cast Film Extrusion

Produces "Soft Feel" Film of Exceptional Clarity and Gloss, High Stiffness

U.S.I. has developed a new 0.933 density polyethylene resin designed for cast film extrusion applications. The new resin – PETROTHENE 218 – has excellent processing characteristics and produces cast film with properties particularly suited to overwrapping soft goods, bakery products or paper.

Cast polyethylene film is an ideal packaging material for a virtually limitless number of consumer products.

Ultra-clarity is a key characteristic of cast film made from PETROTHENE 218. In transmittance and gloss, it equals or surpasses any other polyethylene film in the field. Haze is very low. Moreover, the film is easy to handle on overwrap equipment because of its high stiffness and good heat sealing properties.

For bakery goods, film made from PETROTHENE 218 is ideal. Its "soft feel" imparts a feeling of warmth and freshness, while its natural moisture barrier keeps products fresh longer. Clothing, too, takes on a soft-to-the-touch appearance not possible with "hard finish" overwrap materials.

Easy To Process

The new resin has a density of 0.933 and a melt index of 3.0. Its melt flow and hot-melt extensibility characteristics are excellent, permitting high haul-off rate (>200 ft/min) and relatively thin-gauge films (0.5 mil).

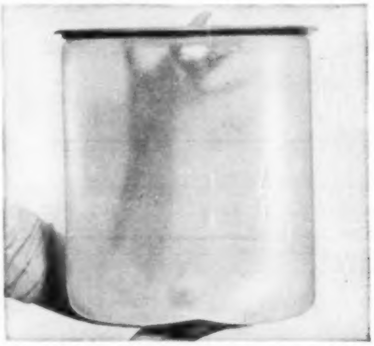
Extrusion stock temperatures of 450° to 550°F and casting roll temperatures of 80° to 170°F have been successfully used. Normally, of course, the highest stock and casting roll temperatures possible under given operating conditions will result in best-quality film.

Printability of films cast from PETROTHENE 218 is excellent. Film has been treated for printability in line with the extrusion process at rates of over 150 ft/min. With a moderate treat level, excellent ink adhesion has been obtained.

The resin is available in three formulations with varying slip levels: unmodified PETROTHENE 218, no slip; 218-26, medium-low slip; 218-27, medium slip.

Polyethylene-Lined Pails Now Used For Shipping Chemicals

Seamless blown-in-one-piece polyethylene liners for steel pails have been developed as another advance in solving the problem of safe and economical packaging of corrosive liquids. This container is expected to find wide application in packaging and shipping products such as acids and alkalies, food concentrates, photographic chemicals, electrochemicals and insecticides.



One-piece polyethylene liner insert permits use of steel pails for shipment of corrosive chemicals. (Photo courtesy Jones & Laughlin Steel Corp.)

The liner is blow-molded of polyethylene in the same manner as a "squeeze bottle," and is then attached to the cover of the outer steel container at the pouring opening, before it is inserted in the container. Its one-piece construction is said to insure against leakage and product contamination.

New Help in Selecting Best Polyethylene Film to Use

A revised edition of the 4-page brochure, *Which Polyethylene Film Should I Use*, incorporating the new Commercial Standard CS227-59 for Polyethylene Film has just been issued by U.S.I. The brochure lists film requirements and resin types suggested for 33 classes of packaged goods, in the terminology used in the new Commercial Standard.

The new U.S.I. brochure provides extruders with an easy-to-use reference to the principal applications of polyethylene film as defined in the new Standard and suggests applicable PETROTHENE resins for these uses. Copies may be obtained by writing to Technical Literature Department, U.S. Industrial Chemicals Co., 99 Park Ave., New York 16, New York.

Series V, No. 4

POLYETHYLENE PROCESSING TIPS

BLOW MOLDING: SELECTING BEST POLYETHYLENE RESIN, OPTIMUM OPERATING CONDITIONS

The objective of any blow molding job is to make the best product possible most economically. To achieve this objective, resin properties and machine conditions, as well as mold cycle time, have to be considered.

The properties sought in the molded product, of course, depend on its intended application. In each case, the molder must consider the relative importance of these factors: stiffness, appearance, gloss, wall uniformity, weld line, parting line, stress crack resistance.

A product's end use determines whether it must be stiff or flexible. For most products, good appearance – high gloss, smooth surface, no flow lines – and durability are required. Uniform wall thickness, strong weld lines and parting lines with the same gauge as the walls are also desired.

Although gloss is considered a requisite for good appearance, it is listed as a separate property here because there are a number of applications in which low gloss is required. Other products may not need high stress crack resistance which may be sacrificed to some degree to improve other properties.

Mold Cycle Time

The molder must also consider mold cycle time – a most important factor in production costs. Obviously, the shorter the cycle, the more economical the process. But here again, other prerequisites must be considered and a balance struck.

Variables Affecting Properties

Table 1 shows the effect of an increase in resin density and melt index and extrusion and molding factors on the properties of the molded piece. Although the information listed has been obtained by extrusion-blow molding 4 oz. Boston round bottles, it generally holds true for all extrusion-blow molding processes within the ranges shown.

The blow molder can use this table to determine which variables should be adjusted to improve a given property. Also he can learn which properties are favorably or adversely affected when resin density and melt index or extrusion and molding conditions are adjusted. Table 1, therefore, is a useful guide for selecting the most suitable resin and adjusting machine conditions to obtain the desirable balance of end product properties.

Table 1 Effect of Resin, Extrusion, and Molding Factors on Bottle Properties and Output [1]

		Resin Properties		Extrusion Conditions			Molding Conditions		
	Increase in these factors → affects these properties ↓	Density	Melt index	Melt temperature	Annular die clearance	Extrusion rate	Mold temperature	Mold time	Blow pressure
Bottle properties	Stiffness	Large increase	NSE	NSE	——	Slight decrease	——	——	——
	Stress crack resistance	Decrease	Large decrease	——	——	——	——	——	——
	Gloss	Large increase	Increase at 0.915 density No effect at 0.932 density	Increase	NSE	——	NSE	Increase	NSE
	Appearance [2]	Improvement	NSE	Slight improvement	NSE	NSE	Improvement	Improvement	Large improvement from 10 to 50 lb/sq in. NSE from 50 to 80 lb/sq in.
	Wall uniformity	NSE	NSE	Slight decrease	Decrease	NSE	Slight decrease	NSE	
	Weld-line thickness (strength)	Large decrease	NSE	NSE	Large increase	NSE	NSE	NSE	Large increase from 10 to 50 lb/sq in. No effect from 50 to 80 lb/sq in.
	Parting-line difference	NSE	No effect at low blow pressure Large increase at high blow pressure	Slight increase	NSE	NSE	Increase	NSE	Large increase
Mold cycle time		Large decrease	NSE	Increase	Increase	——	Large increase	Large increase	NSE
Range of tests limited to →		0.915 to 0.932 g/cu cm	1.3 to 4.7 g/10min	300 to 340 °F	54.5 to 79.5 mil	0.2 to 0.4 in./sec	80 to 160 °F	12 to 24 sec	10 to 80 lb/sq in.

NSE – no significant effect

1) tests on 4-oz Boston round bottles

2) qualitative rating of gloss, surface smoothness, and flow lines in bottle

Table 2
PETROTHENE® Resins for Blow Molding

PETROTHENE	Density	Melt Index	RATINGS: Stiffness	RATINGS: Melt Flow	RATINGS: Stress Crack Resistance	RATINGS: Fast Cycle Time	RATINGS: Overall Appearance	Bottle Application
101*	0.924	2.0	5–	4–	4	4–	5	up to 32 oz.
102-2*	0.924	2.0	5	4	4–	4	5	up to 32 oz.
209-2*	0.920	3.0	4	5	3	5	5	up to 16 oz.
301	0.916	1.0	4	3	5	3	4	all sizes

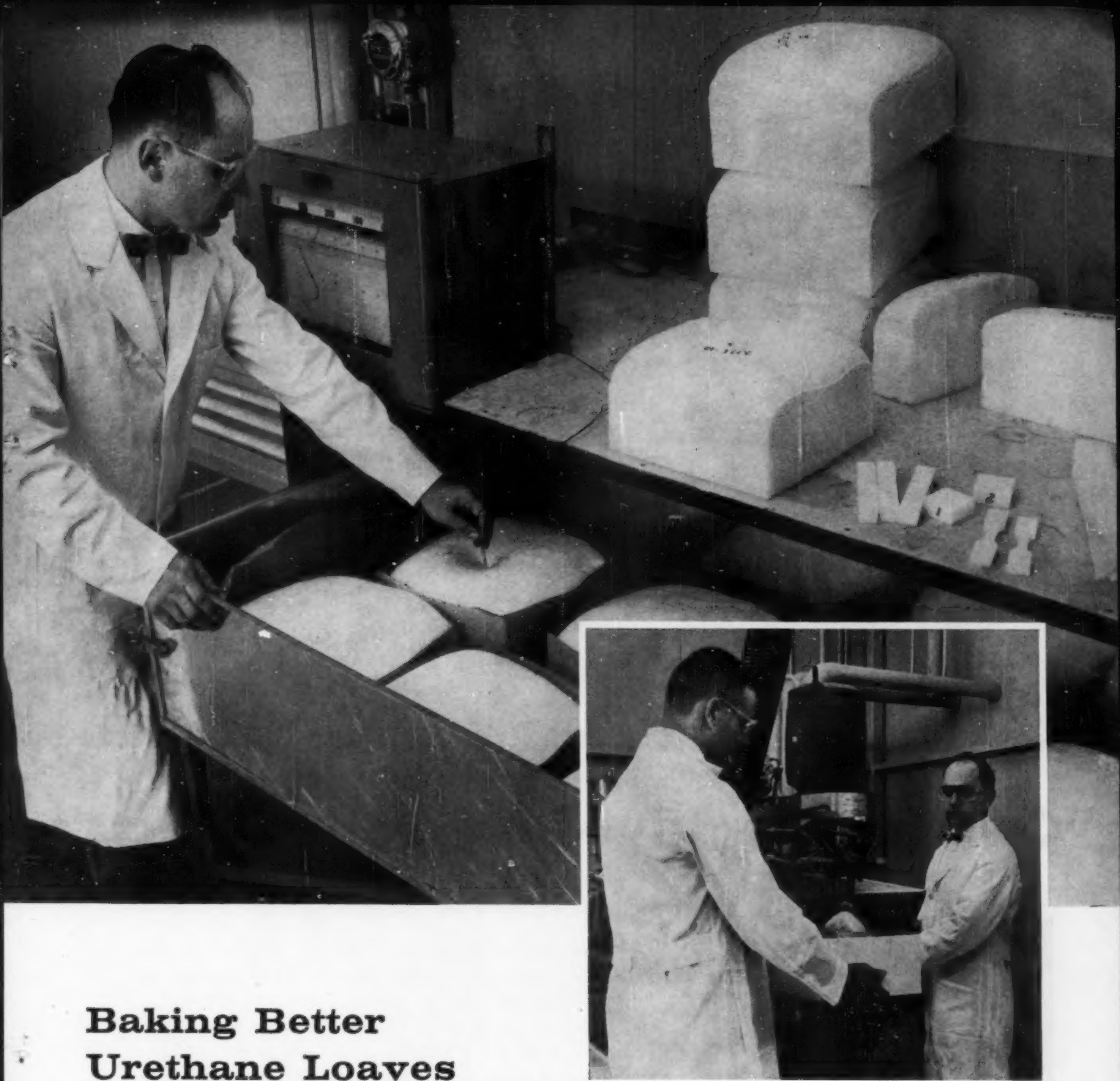
*Technical data sheets available.

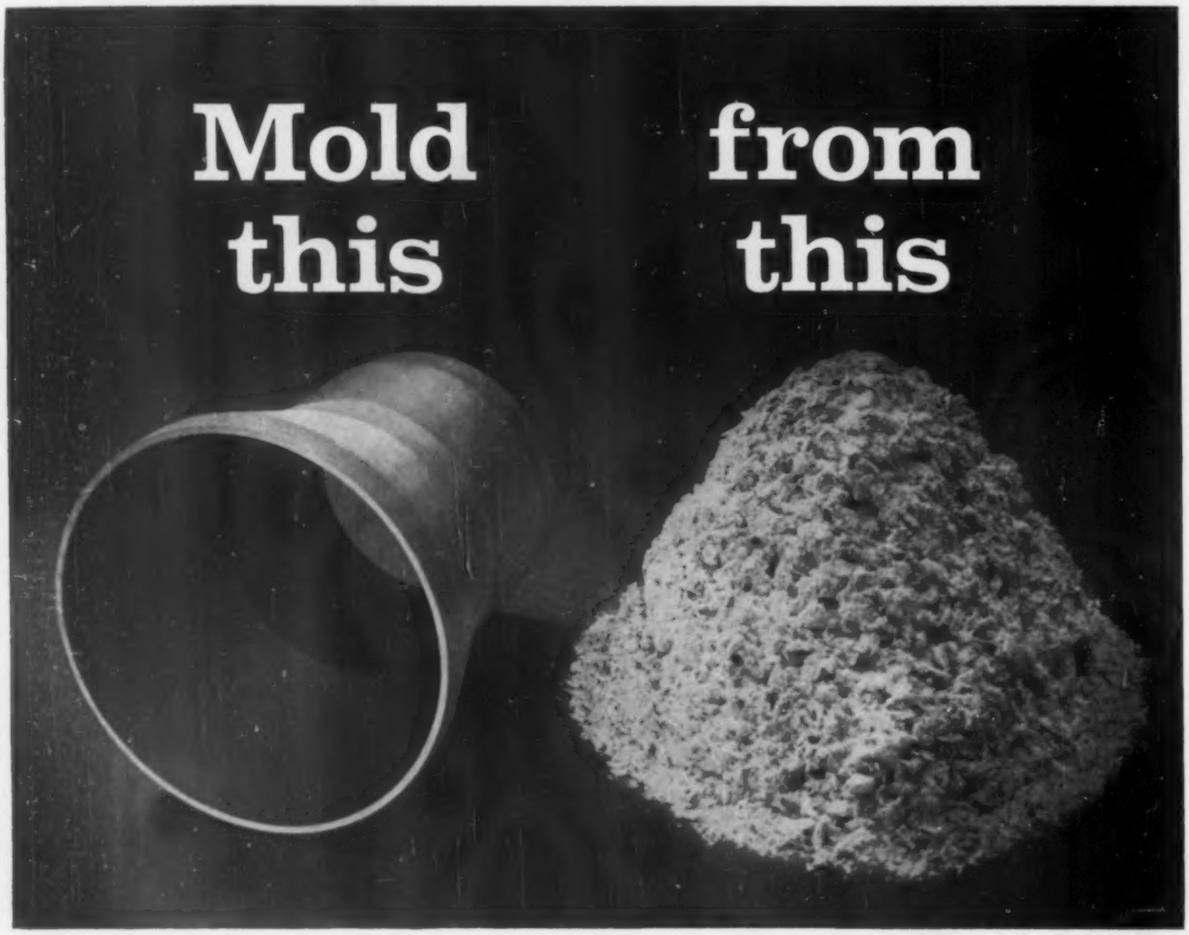
Table shows the relative rating of each resin in each category listed. The highest numerical rating indicates the best resin in each category.

Blow Molding Resins

Table 2 lists four PETROTHENE® resins which are suggested for blow molding. Of these, PETROTHENE 101, 102-2 and 209-2 represent the latest U.S.I. developments in the blow molding field.

U.S.I. has prepared a technical data brochure on blow molding, containing detailed information obtained in the course of an elaborate research program. Ask for a copy. Technical data on other areas of interest to blow molders not yet investigated will be released as soon as available. For information in these areas, or for assistance on any aspect of blow molding, contact the U.S.I. Sales Office nearest you.





...for missile parts of high-temperature asbestos-phenolics— R/M style 150RPD molding compound

Virtually every U.S. missile carries plastic parts made of R/M raw materials. Starting point for many of these parts exposed to burning propellants and other high-temperature environments is R/M style 150RPD molding compound.

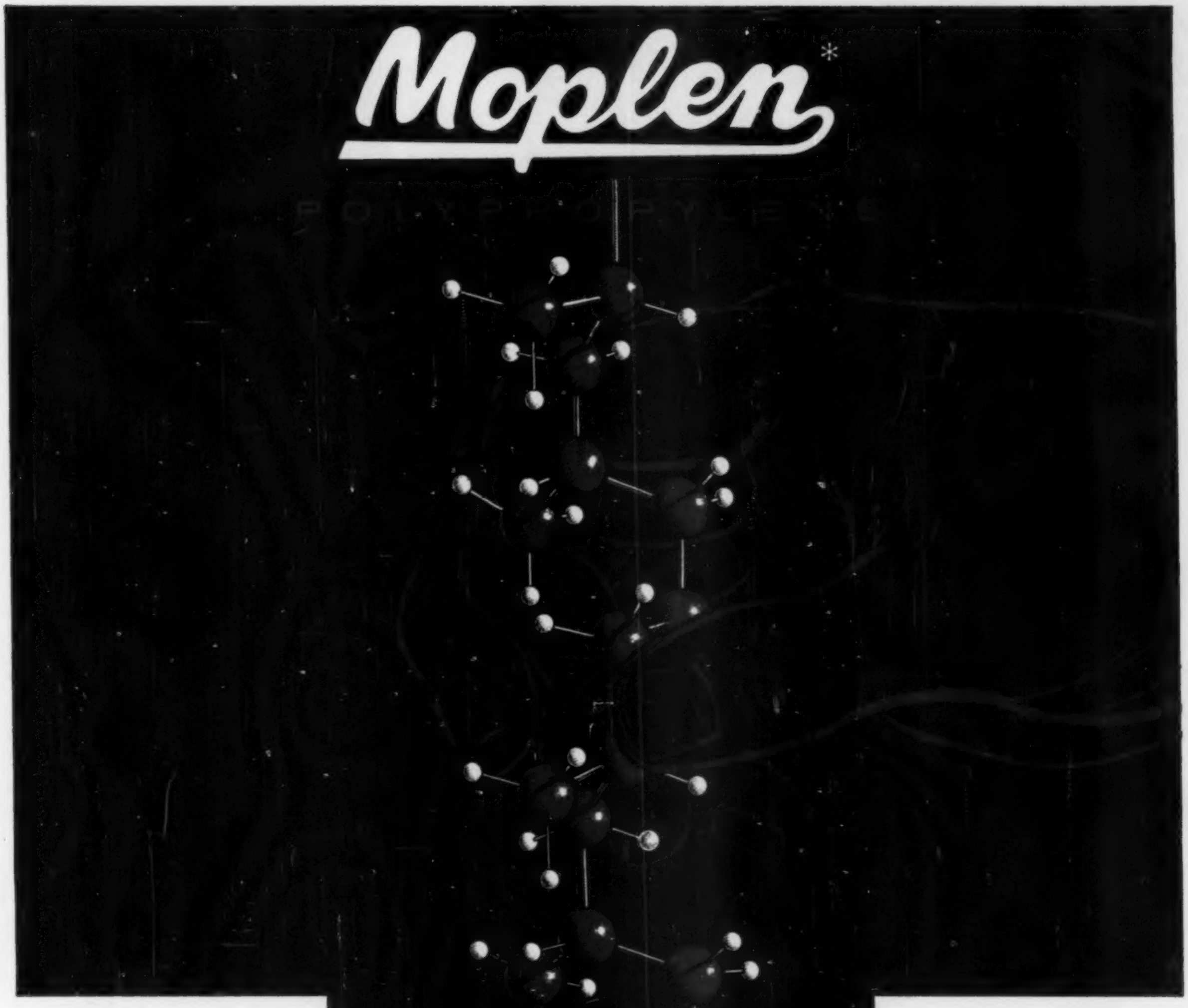
The extra-long spinning-grade asbestos fibers which form the basis of this R/M material provide a unique combination of properties: high-temperature insulation, low thermal diffusivity, excellent resistance to ablation and shock, high strength/weight ratio, and good strength retention after exposure to high temperatures. No other molding compound offers all these advantages plus the handling ease inherent in R/M style 150RPD.

Investigate the extraordinary strengths of R/M style 150RPD molding compound for parts which must take heats as high as 10,000°F for short periods. Available for immediate shipment in production quantities. Write for information on molded billets for research purposes. Reinforced Plastics Department, Raybestos-Manhattan, Inc., Manheim, Pa.

R/M

RAYBESTOS-MANHATTAN, INC.

SPECIALISTS IN ASBESTOS, RUBBER, ENGINEERED PLASTICS, SINTERED METAL



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MONTECATINI

milestone in the conquest of inner space

Everywhere chemists are exploring the way molecules are put together...putting atoms together in exact, predetermined relationships with each other . . . producing spatially-ordered molecules . . . making useful products from these polymeric materials with designed-in properties for specific applications.

Leader in this conquest of inner space is Montecatini, who developed the first stereospecific polymer, MOPLEN® polypropylene. The forerunner of a revolutionary class of plastic materials discovered by Giulio Natta of the Polytechnic Institute of Milan, MOPLEN® is being widely used in Europe and in the United States.

Montecatini continues to explore this new world of structural chemistry . . . is developing new polymerization catalysts and producing new polymers with exciting potential as plastics, textile fibers and elastomers in the products of tomorrow.

Wherever you are in the world, you can put these discoveries to work for you. Look to Montecatini for MOPLEN® . . . and for new advances in the conquest of inner space.

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August 1960, Volume 37, Number 12

MODERN PLASTICS

Photo, Continental Can Co.

For versatility unlimited: FILM LAMINATIONS

Latest engineering materials give manufacturers important design tool for new and upgraded products. Here are the most significant laminations available, where they are used, and how much they cost

Manufacturers considering the use of plastics film laminations face a truly staggering multitude of choices. With about 30 plastics and non-plastics films available, the number of possible combinations goes into the millions. Of course, not every one of these combinations has been produced—or is feasible—but to show that this is not a statistical game, one company, since the late 1930's, has produced over 1200 different laminations. And for every new film that is introduced (some recent examples: Teslar vinyl fluoride, polypropylene, vinyledene fluoride), hundreds of additional combinations become theoretically possible.

What are the most important of these laminations? What films are involved? Where are they used? What can they do? How much do they cost? Who are some of the makers? Why do they bring worthwhile economies to the manufacturer using them?

Plastic film laminations are synergistic. They provide a range of desirable properties not

DECORATIVE, SCUFF-RESISTANT laminations of embossed metallized Mylar and cellulose acetate butyrate are used for trim in cabins of Eastern Air Lines new Golden Falcon Electra aircraft. Laminate is produced by High Vacuum Metals Inc., using Kodapak II sheet.

REFRIGERATOR INSULATION that is 50% thinner than formerly used glass batting is made possible by lamination of polyester film, kraft paper, and saran film, fabricated into bags containing 1½ in. of glass fiber insulation. Using this construction, Hotpoint Co. can transform 14-cu.-ft. refrigerator to 18-cu.-ft. model without increase in outside dimensions. Laminate is produced by Arvey Corp.

MIDWINTER SUN TAN can be acquired—without a trip south—by means of portable Tin-Tan, a box fabricated of metallized Mylar-vinyl film lamination by Arvin Industries.

present in the individual components. They fill an expanding variety of end-user needs, because it is recognized that there probably never will be an all-purpose plastic film. In cases where a single material cannot offer all the necessary characteristics, they can often be obtained in a stock lamination, scores of which are available from companies specializing in this field. If necessary, however, custom laminations can be developed to meet almost any specification required.

Table I, p. 82, summarizes the properties of approximately 40 stock and special laminations available from various suppliers. While this tabulation does by no means include *all* laminations now being produced, it brackets a broad cross-section of end-use applications and probably covers most of the major types of flexible laminations currently available. Thus, it may be used as a preliminary guide in projecting new end-uses. It should not be assumed that the company listed as the supplier of each lamination is necessarily the *only* source available for this particular type. In many instances, substantially similar laminations may be obtained from more than one supplier.

The production of plastic film laminations is a highly specialized business involving relatively expensive equipment and considerable know-how on plastic and non-plastic materials, adhesives, and production methods. A fully equipped laminator must be set up to process

a wide range of materials requiring different handling methods. Often, his equipment includes not only that used in the actual laminating process (four basic production methods are recognized) but also printing presses, slitters, vacuum coaters for metallizing plastic films, and other types of capital equipment.

PERFORATED TAPE (inside blue border) is a lamination of Mylar and paper. Used on an automatic typewriter, it has shown over 300 times the service life of paper tapes. With growth in automation, such tapes are a growing market for laminations.

Getting a line on costs

The cost of plastic film laminations depends mainly upon the unit cost and thickness of the materials used. At the lower end of the price scale are simple laminations of PE and paper, widely used in packaging applications. Laminations incorporating cellulose acetate, saran, polyester, and other more expensive films are generally more costly, but are used primarily in end-use applications which can afford higher material costs.

Some idea of comparative costs for representative laminations may be gained from Table I. However, in many instances, manufacturers were unable to release specific cost figures because materials listed were produced on a custom basis, with costs held confidential. Also, in arriving at a true cost comparison, due allowance must be made for the thickness of the individual plies and the complete lamination. At any rate, the table is offered only as an approximate guide; specific information on costs and properties of the laminations, should come from the companies which produce them.

Choosing the right lamination

How should a company go about selecting the best lamination for a given end usage? Reference to Table I will provide basic data on typical laminations now employed in a variety of products ranging from packages and electrical insulation to automotive and aircraft interior trim, "high fashion" wallets, and other accessories and high altitude research balloons. Table I also identifies the components in many of the laminations listed. The table also yields helpful data on approximate costs.

Most contemplated applications for plastic film laminations will be related either directly or indirectly to some of the applications in Table I. Once a lamination having approximately the required properties and price range has been located in the table, potential users would be well advised to contact one or more of the companies specializing in these laminations, as listed at the bottom of the table, giving them the end-use application, conditions under which the material must perform, and equipment on which it will be handled. With this information, laminators should be able to come up with a stock or special construction which will fill the bill.

Some successful applications

Film laminations have been used in packaging more than 20 years. However, their application in this field has multiplied in recent years. The availability of new high-performance films and the growing popularity of portion packs and other convenience-type packages are two factors accounting for this growth. Another is the steadily rising cost of rigid containers and the ever-tightening squeeze on shipping space and costs. Still another is the fact that functional film laminations have made totally new types of packages possible, such as the familiar bags or pouches in which sliced luncheon meats, cheese, etc., may be packed, polyethylene-polyester "boil-in-the-bag" packages, and others. Early problems of inadequate bond

Turn page for table on applications and cost data of representative film laminations. Article continues on page 84.

Table I: Applications and cost data on

Typical applications	Mfr.[b]	Mfr.'s designation	Components of laminate	Approximate cost, cents
Air-supported buildings, high-altitude balloons, bags, sacks, greenhouses, tarpaulins, tents, protective clothing, etc.	(4)	Fabric-Film-Type 82	Two layers of 3.3-mil vinyl, Dacron reinforced	5/sq. ft.
Same as above	(4)	Fabric-Film-Type 65, white	Two layers of 2.2-mil white PE, Dacron reinforced	2.7 to 4.7/sq. ft.
Same as above	(4)	Fabric-Film-Type 92	Two layers of 1-mil weatherable Mylar, Dacron reinforced	15/sq. ft.
Same as above	(4)	Fabric-Film-Type 91	Two layers of ½-mil Teslar PVF film with Dacron reinforcement	10/sq. ft.
High performance, very high altitude balloons	(1)	R-V-CX 25	Various plastics, fabric reinforced	25/sq. ft.
High performance, air supported structures	(1)	R-V-CX 30	Various plastics, fabric reinforced	45/sq. ft.
Class A electrical applications	(1)	R-V-JE 14A	Duplex cellulose acetate lamination to 100% rag paper	Varies, depends on combination
Same as above	(1)	R-V-JE 1A	Duplex polyester film lamination to 100% rag paper	NA[c]
Class B electrical applications	(1)	R-V-JE 9A	Triplex polyester film and Quinterra asbestos lamination	NA[c]
Insulation, where very high degree of moisture impermeability is required. Also in Navy hutting program	(5)	Vapor barrier material	Lamination of aluminum foil and polyester film	NA[c]
Government and industrial heavy-duty packaging. Large machine packaging, rifle bags, etc. MIL-B-131C, Class I	(2)	Barrier material MIL-72	44 x 40 cotton scrim 0.001 PE/0.0005 foil/ 0.0025 PE	0.448/1000 sq. in.
Small electrical and auto parts, case liners, etc. MIL-B-131C, Class II	(2)	Military barrier material MIL-60	50# kraft/0.001 PE/ 0.0005 foil/0.0025 PE	0.266/1000 sq. in.
Heat-in-bag packaging	(2)	50M/100F/30P	Mylar plus aluminum foil plus polyethylene	0.309/1000 sq. in.
Packages for dry salad dressing mix, dry cream powder, dry yeast, dehydrated eggs, ice cream mix, etc.	(2)	88A/100F/80R (T-T)	Cellulose acetate plus aluminum foil plus Pliofilm	0.301/1000 sq. in.
Cook-in pouches, dried beef and lunch meat pouches, shrimp and lobster pouches. Drum liners and heavy duty pouches (100M/37P)	(2)	50M/30P 100M/37P	Mylar plus polyethylene	0.189/1000 sq. in. 0.254/1000 sq. in.
Packaging of frozen orange juice, frosting, cottage cheese, etc.	(2)	130C/30P	Cellophane plus polyethylene	0.124/1000 sq. in.
A) Pouches for dried beef, chipped ham and textile dyes; B) Packaging of coconut, photo films, and other very hygroscopic products	(2)	(A) 130C/10P/35F/30P (B) 130C/7P/35F/15P	Cellophane plus polyethylene plus foil plus polyethylene	0.205/1000 sq. in. 0.180/1000 sq. in.

representative plastic film laminations[a]

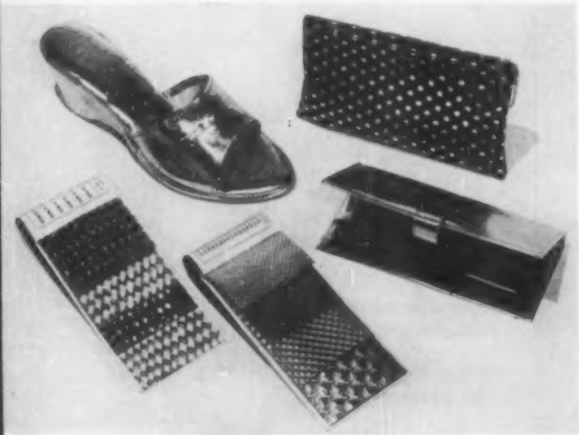
Typical applications	Mfr.[b]	Mfr.'s designation	Components of laminate	Approximate cost, cents
Liner stock for closures used on glass, metal, and plastic containers	(7)	Sicoran WS	75-gage saran bonded to 50-lb. white sulfite paper	Clear saran, 24/sq. yd.
Same as above—especially for use on products with volatile solvents such as nail polish remover, etc.	(7)	0.001-in. white Mylar W. S.	100-gage polyester bonded to 72-lb. paper	NA[c]
Drink mix powders, dry cake mix, photo chemical powder, cleaning powder, etc.	(2)	24GG/35F/15P (T) 25WR/35F/15P (T)	Paper plus aluminum foil plus polyethylene	0.151/1000 sq. in. 0.146/1000 sq. in.
Frozen food warehouses, pipe coverings, refrigerated trucks and railway cars. Applied to structural materials with MEK adhesives	(1)	R-V-JZ-2	Aluminum foil plus polyester	15/sq. ft.
Fabricated into bags to contain gas used for thermal insulation, reducing required wall thickness	(1)	R-V-CP-91	Saran plus kraft plus polyester	13/sq. ft.
Sheathing for pipe insulation where high degree of moisture protection is required	(1)	R-V-CP-54	Flame resistant vinyl, aluminum foil, asbestos	9/sq. ft.
Protective lamination for book cloth	(1)	Lamcote	Polyester, acetate, vinyl to basic book covering material	NA[c]
Generally perforated for use in fancy grilles on appliances	(1)	R-V-CP-95	Polyester surface film on backing material	NA[c]
Used principally for loose leaf binder combs	(1)	R-V-CX-4	Metallized polyester on heavy backing	NA[c]
Matchboard covers	(3)		Acetate laminated to match folder stock	NA[c]
Master control tapes for data processing equipment	(1) (3)		Mylar plus aluminum foil and Mylar plus selected paper	NA[c]
Decorative trim	(6)		Mylar, vinyl, and cloth backings	NA[c]
Decorative covering for aircraft baggage rack handrails, seat bases, etc. Shoe coverings, belts, handbags, and other apparel and accessory applications	(5)	Chromeflex	Metallized Mylar plus Kodapak butyrate sheet, laminated to airplane cloth	NA[c]
Displays, packages, novelties, interior trim, appliance components	(6)	Mylar/vinyl fabric	Combinations of Mylar, vinyl, cloth	0.20/1000 sq. in.
Essentially same as above	(6)	Mylar/vinyl	Metallized Mylar backed with vinyl film	0.15/1000 sq. in.

[a] This table contains no property information (moisture-vapor transmission, tensile strength, chemical resistance, etc.). The exact range is too broad to permit ready tabulation in this limited space. However, applications listed in the first column are fairly indicative clues to the properties provided by the laminates in question, and can be used as an approximate and initial guide in selection.

[b] Key to manufacturers listed in second column:
1) Arvey Corp., Lamcote Div., 3500 N. Kimball Ave., Chicago, Ill.
2) Continental Can Co. Inc., Flexible Packaging Div., Mt. Vernon, Ohio.
3) Dobeckmun Co., Div. of The Dow Chemical Co., P. O. Box 6417, Cleveland, Ohio.
4) Griffolyn Co. Inc., 6813 Dixie Drive, Houston, Texas.
5) High Vacuum Metals Inc., 40 Worth St., New York 13, N. Y.
6) Lamart Corp., 16 Richmond St., Clifton, N. J.
7) Standard Insulation Co. Inc., East Rutherford, N. J.

[c] Not available. Some idea on cost can be obtained by consulting "Cost Table: Papers-films-foils," MPl, Jan. 1960, p. 106. The table incorporates price information on materials used in making laminations.

SURGICAL SUTURE PACKAGE, developed by Ethicon Inc., consists of a special Metalam lamination of aluminum foil, vinyl film, and paper designed by The Dobeckmun Co., Div. of Dow Chemical Co. For details, see text below.



HIGH-STYLE SHOES, handbags, and other accessories are fabricated of metallized Mylar supported by vinyl film and cloth backing. In foreground are several samples indicating range of design potential possible with these materials. Laminations produced by Lamart Corp.

strengths encountered with the latter type of lamination have been overcome by using thermosetting adhesives, primarily of the polyester type, which yield bonds exceeding the internal strength of the films themselves.

Sometimes a specialized type of lamination is required to fill unusual packaging assignments. Ethicon Inc. wanted a package for surgical sutures which would permit electron beam sterilization of the sutures after packaging. The package had to be easily handled and opened without scissors or other instruments, eliminating the problem of broken glass encountered with other types of packages. The material specified for the resulting package was a lamination of aluminum foil, vinyl film, and paper developed by Dobeckmun Co.

With continued extension of the self-service trend in many fields, use of plastic film laminations in packaging should soar to new heights. Entirely new markets—such as those envisioned by Minnesota Mining & Mfg. Co. for a projected polyester-paper laminate container for petroleum products—could open up fantastic volume potentials. This container, now in the development stage, is low in cost, offers opening convenience and easy disposability, allows 35% more storage space at the service station, and takes up only 1/7 the amount of space when empty as that required by presently used metal cans.

Trim and accessories that can take it

Many decorative and trim materials used to impart color and texture to basic surfaces are easily soiled or highly susceptible to damage by flexing, scuffing, staining, and other types of abuse. Special types of plastic film laminations, most of them incorporating a layer of polyester film, have given manufacturers a broad new choice of colored and textured materials which resist most types of damage, are easily applied because their flexibility permits them to conform even to contoured surfaces and, in many instances, are more economical than the materials replaced.

Fasson Products, Painesville, Ohio, recently introduced a group of self-adhesive Mylar-vinyl laminates that will supplant metal in many applications. The sub-surface vinyl film, 4 to 12 mils thick, adds body to the laminate and permits deep decorative embossing. These materials offer substantial savings in production and application costs by eliminating tooling charges as well as fastening devices.

Similar laminations are used for such products as trimmings and bindings, fabrics, belts, wallets, and ladies' footwear. In some constructions, a fabric backing is added for additional strength. Sold in rolls, these laminations may be fabricated into hundreds of end products by die-cutting, stitching, sewing, tailoring, twisting, shaping, embossing, cementing, and other techniques. Among the companies specializing in this type of laminating is Lamart Corp., Clifton, N. J., which produces a variety of stock laminations and can also develop non-standard constructions to met specialized needs of the end user.

Typical products which may be fabricated from such laminations (To page 185)

When and how to use pressure forming

Specialized sheet forming technique, particularly suited for hard-to-form materials, uses up to 300 p.s.i. air pressures. Initial market is packaging.

Next step: automotive and refrigerator parts

By Eli A. Haddad*

History proves that new methods of processing plastics augment, rather than replace, previous methods, building a family of technologies and molding methods. These processes compete with each other, but they also enlarge the industry's capabilities.

In the sheet forming or molding field, we have a new offspring in the family—pressure forming—and it is destined to become a giant. In the past two years this dormant infant began to be thoroughly explored in many excellent presentations, articles, and seminars. The early pioneering work of Louis Pfohl of Plaxall Inc., Emhart Manufacturing Co., Plax Corp., and the Auto-Vac Div. of National Cleveland Corp., all began to excite honest interest. The whole field of pressure forming has benefited from some of the most active and accelerated thinking in the industry. Today it is opportune to witness what this technology is —and what machines, materials, and markets are keyed to this pressure forming trend.

It has been said that the pressure forming process for thermoplastic sheets picks up where vacuum forming leaves off. In the new techniques of pressure forming, the pressures used, or the forming force, range from 50 to 300 p.s.i. (compared to about 14.5 for standard thermoforming). Pressures of this order of magnitude proved necessary *if* mold detail was to be reproduced with satisfactory high frequency and fidelity, *if* dimensional detail was to be constant from part to part, *if* uniformity of wall thickness was to be a major objective, and *if* the newer, tougher, thermoplastic sheets were used to open up new applications.

Figure 1, right, shows the sequence of the pressure forming technique.

In most plants, air pressures from 100 to 120

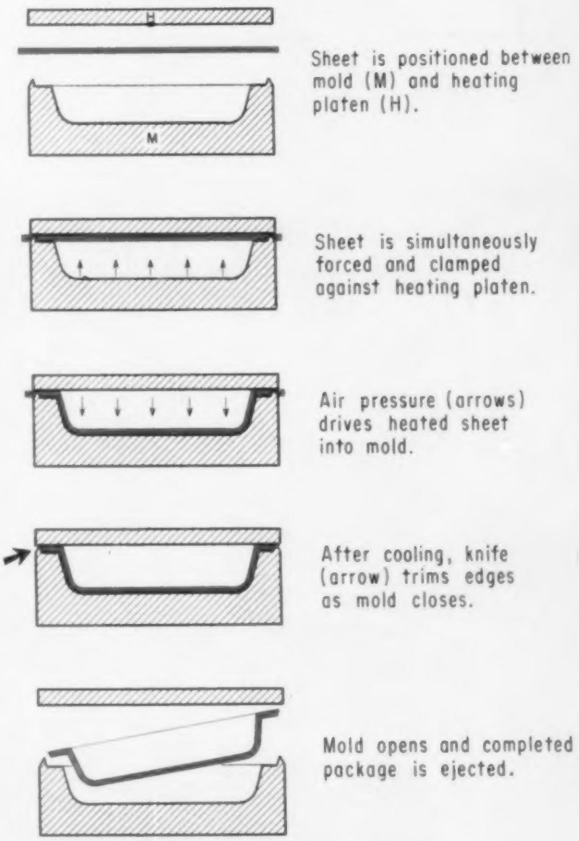


FIG. 1: Schematic diagram of pressure forming process. Sheet is shown in color. Mold and heating platen are identified by letters. Sequence is from top to bottom.

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*See p. 87.

From a paper presented at the 1960 SPI Conference—Western Section, Palm Springs, Calif., April 8, 1960.

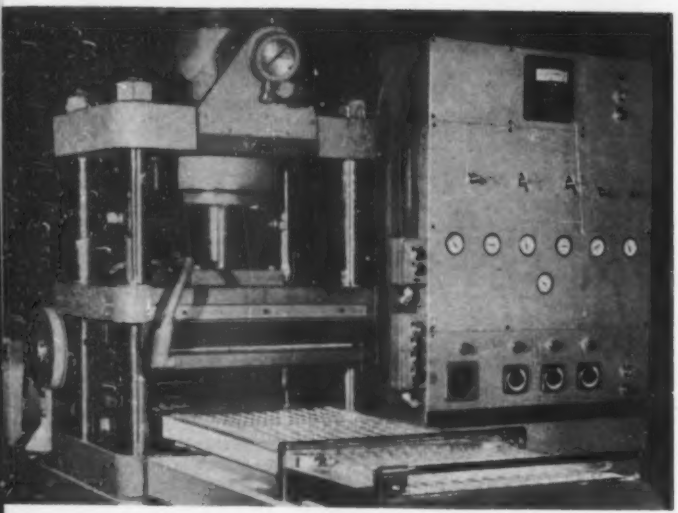


FIG. 2: Portion packages being pressure formed on machine produced by Auto-Vac., Div. of National Cleveland Corp.

p.s.i. are used. After an article is cooled, the formed section may be ejected by air and post-trimmed, or, as in some machines, the cam-controlled mold advances another fraction (0.25) of an inch and trims the part in place, after which it is ejected.

The technique involves contact heating, with the sheet, clamped between a mold and heater, being held against the heated metal surface. It is easy to stop the heat transfer simply by blowing the sheet away from the heater. Obviously, the heat transfer rate is improved as more intimate contact is obtained; therefore, as a matter of control, it is essential to eliminate entrapped air which could insulate the sheet from the heater—but venting entrapped air is effective only as long as each of the vent holes remains open.

If readers will recall the variation on Parkinson's Law—"if anything can go wrong, it will"

FIG. 3: Plastic lid forming machine, Model 132, made by Emhart Mfg. Co.'s Portland Div., contains 12 forming heads and six individual forming stations.

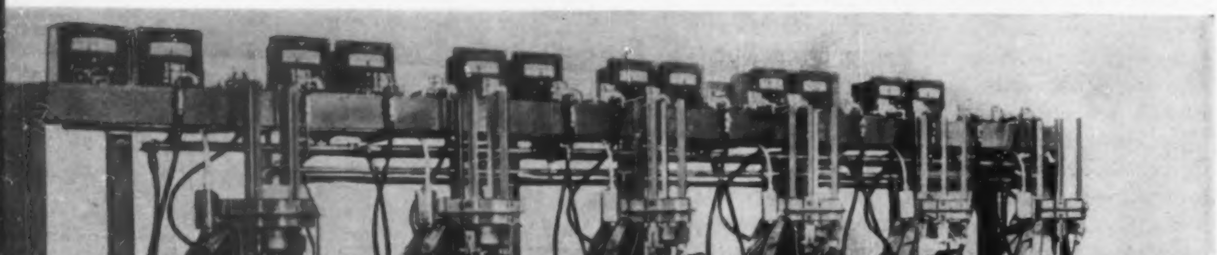


FIG. 4: Unit portion cups and lids are pressure-formed of cellulose acetate by Plaxall Inc. on equipment leased from Design Center Inc.

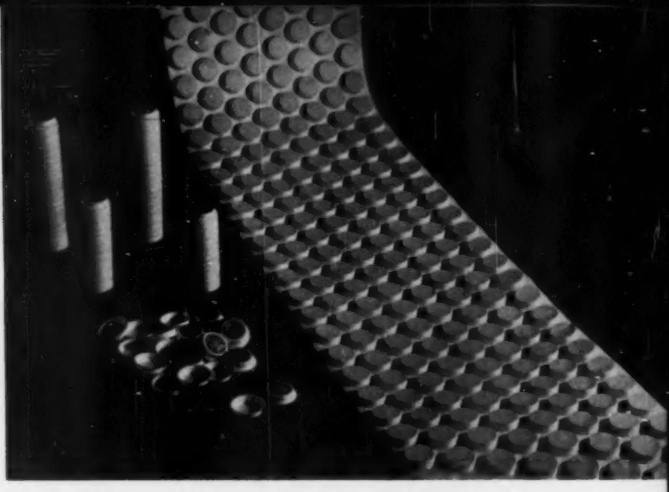


FIG. 5: Milk bottle caps are pressure-formed from non-toxic vinyl by Sealright-Oswego Falls Corp., using Design Center equipment.

—it is evident that if the softened sheet can close the vent hole, it will.

It goes without saying that the tools, dies, and machines which are used in pressure forming—if they are to produce precision parts—must be precision made. The mold materials currently used include various forms of metal—some cast, some machined; occasionally the industry uses epoxy-based molds, especially for prototype development. The design of the tools is at times more critical because heat and pressure are major considerations, although the industry to date has evolved certain principles in designing tools. Each new application must be analyzed by itself.

While it is possible to rebuild a metal working press, by adding controls and tools, to pressure form articles from plastics sheets or webs, the trend is toward the professionally-built machine in which trimming the pieces is precisely registered with the forming operation, both being automated.

Figures 2 and 3, left, show two such machines. One is a pressure vacuum unit made by Auto-Vac Div., National Cleveland Corp. The other is the Emhart 132 machine made by Emhart Mfg. Co. Basically, this machine consists of six individual forming units. Each unit is comprised of a feed section for feeding blanked disks, a small hydraulically operated press, and suitable mold motions to form covers that are used for containers.

The Model 132 Emhart machine can make lids on a 3.5 sec. cycle utilizing all six forming heads. It can produce 6000 closures/hr./machine, can form clear or opaque sheeting, either oriented styrene or high impact types.

The critical dimensions of the closures are extremely uniform. For example, **(To page 189)**

FIG. 6: Food container lids pressure-formed from oriented polystyrene by Plaxall.

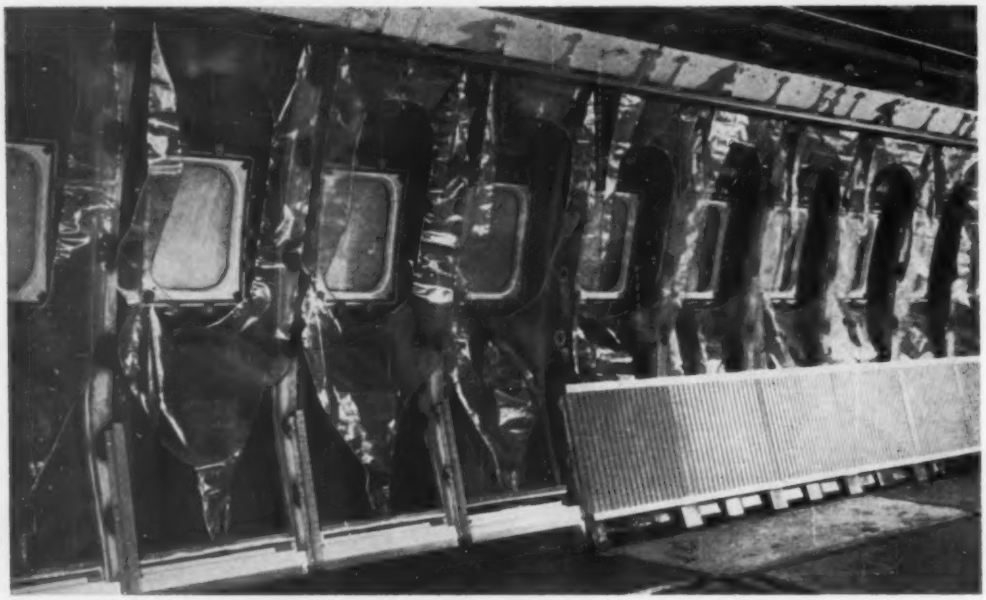
ELI A. HADDAD, Manager of Technical Service, Plastic Products, for Monsanto Chemical Co.'s Plastics Div. at Springfield, Mass., has been with the company since 1944.

A graduate of Holy Cross College in 1940 with a BS degree in chemistry and a certificate in chemical engineering in 1941 from the Massachusetts Institute of Technology, Eli has held important posts in the service and development departments of both Monsanto and its associate companies, Shawinigan Resins Corp. and Plax Corp. He was Assistant Director of the Technical Service Dept. in 1959, when he was appointed to his present position.

Eli is the author of several papers on extrusion technology and applied plastics, especially in the field of packaging, as well as a management article on the concept and role of technical service in the plastics industry. He is a member of the Commercial Chemical Development Assn., the Education Committee of the SPE, the Society of American Military Engineers, British Plastics Institute, and the ACS.

He studied business administration at Northeastern University.

AIR CONDITIONING WITH



BOEING 707 with heat-sealed polyester bags installed around windows. Tapered ends are attached to riser ducts and bags are ready to be covered with interior trim panels (right). The entire installation (90 bags) takes only about six hours.

Air conditioning of giant jet transports is being accomplished quickly and economically for Boeing Airplane Co. with the help of heat-sealable polyester bags—which eliminate air leakage from the cabin walls and provide improved heat control and air distribution. Previously, air leakage was on the order of 30 to 40 percent.

In addition, this new and easier air-condition method, first introduced about three months ago, has enabled Boeing to completely install its air-conditioning side-wall system in each cabin in less than six hours. Under the formerly used system, this was at least an 8-hr. job. In fact, this application has become so successful that today all of Boeing's new 707 and 720 jet airliners are being so "outfitted."

This marks the first time that polyester film has ever been used for air-conditioning purposes. The film—Scotchpak No. 20A5, produced by Minnesota Mining & Mfg. Co.—is 2 mils thick and can be heat sealed at temperatures up to 400° F. Prior to this use, the plenum or space between the inner and outer walls of the craft was used to hold the conditioned air. But this required extensive tape sealing of joints and cutouts to minimize air leakage. Numerous rolls of cloth tape had to be applied around the cutouts and joints.

The main feature of the new technique, of course, is that it enables complete control of air distribution. This has led to greater passenger comfort—since faster, more effective temperature control is provided.

In addition, a tiny hole—about 0.064 in. in diameter—in one side of each bag allows air to be forced into the space between the outer and inner windows to keep them free of fog and frost. A small, rubber disk—resembling a grommet or washer—is around the hole, enabling it to be easily attached to the window.

The bags are not connected to one another, but are attached side by side and along each side of the approximately 1200-in. long cabins. Each bag is taped to a metallic tube (riser), which extends from distribution ducts located under the floor.

The conditioned air circulates through the

POLYESTER BAGS

Jet passenger comfort is improved, air leakage reduced, and installation cut by 20% through use of fabricated polyester bags installed in walls of craft

CLOSE-UP OF BAG. Air enters the passenger compartment by passing through elongated holes in stamping at the top of the bag.

ducts, into the risers, through the bags and then out into the passenger compartment after passing through elongated holes in a PE sheet stamping on top of each bag. Approximately 90 of these bags are installed in each craft.

How it's done

1. The top of each of the 24-in. wide by 4-ft. high bags is attached to a horizontal bar extending along both sides of the cabin above the windows. This is accomplished by inserting a sheet stamping of high-density polyethylene (Marlex 50, Phillips Chemical Co.) at the top of the bag into the slot on back of each bar. Two metal clips, on each side of the stamping, are then hooked over the bar.

2. A rubber disk is then slipped over a small tube on the left corner of each window. Insertion of the tube into the disk allows the air to gain entry into the window space.

3. The tapered bottom of each bag is then attached over a riser and the bag end wrapped with a small amount of tape in order to assure maximum attachment of the bag around the riser opening.

After all the bags are in place, wall panels are attached over the bags and the installation is complete. No special or difficult-to-handle equipment is needed—and there are no clean-up problems to solve.

The bags are fabricated by Polyfab Co., Los Angeles, Calif., and Fabricators Inc., Seattle, Wash., in the shape desired. No heat sealing is necessary by Boeing, since all the sealing of the film is done during fabrication. The film roll is simply cut according to the pattern of the templet that is laid over the film on a work table and then sealed. Weight of each bag is 2 ounces.

The experience of Boeing suggests that similar system might be installed by other airlines. It also seems feasible that such bags may find application in other transport vehicles and building construction.—End

RUBBER DISK allows some flow of air from the polyester bag into the area between the inner and outer windows of the airplane.

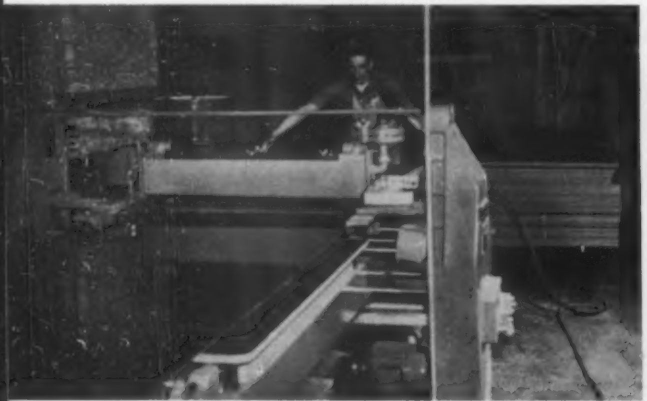
AFTER GROMMET HAS BEEN ATTACHED, tapered section of the bag is placed over riser leading from the distribution duct that is located under the floor. Following this step, the bag is taped around the riser.

DESK AND LAMP TABLE have diallyl phthalate laminate tops and skirts. Production method by which these laminates were produced is illustrated in Photos 1 through 4, below.

From their more esoteric and familiar use in the molding of precision electronic components for rockets and missiles, diallyl phthalate resins have suddenly found themselves elevated to a new and challenging position as a major competitor for the decorative laminate business. The catalyst behind the move: a reported one-third and one-half savings in production costs over typical high-pressure laminate constructions based on melamine or phenolic.

Since they are not condensation resins and do not create water on polymerization, the diallyl phthalate resins, as used in impregnated laminating papers, can be applied with presses that exert as little as 100 to 250 p.s.i. In the over-all cost picture, this means that fairly inexpensive core materials, such as chipboard, particle board, or cement board, can be used without any danger of being crushed by the pressures involved. The diallyl phthalate-

How simulated wood surface is



1 In production line shown here, a diallyl phthalate-impregnated overlay and a similarly impregnated printed paper were used to create an attractive and durable simulated walnut surface on a 3/16-in. hardboard. Hardboard is fed into a flow coater which applies the necessary primer. Boards are automatically stacked after coating for about a 1-hr. drying period.

2 Two sheets of saturated paper (the printed mahogany paper is on the bottom, the translucent overlay which will become clear during lamination is on top) are unrolled simultaneously from a special rig. The two pieces are cut and handled together for maximum efficiency. The rolls are supplied about 2 in. wider than the boards to keep waste to a minimum.

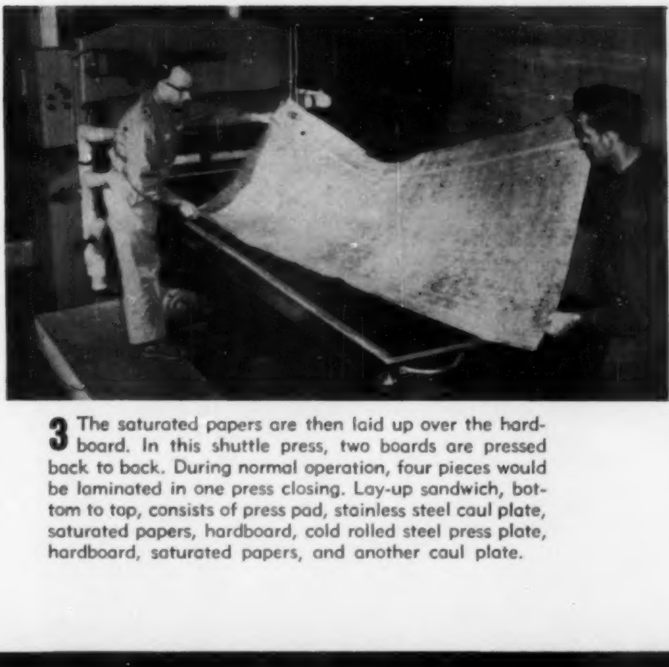
Requiring relatively low pressures, diallyl phthalate-impregnated papers can be applied directly to wood veneers or other cores in simple, one-step operation that can spell economies for users

laminates: DAP

impregnated surfacing papers can also be applied to the base core in a simple one-step operation. The conventional two-step process, in contrast, requires first the production at high pressures (800 to 1000 p.s.i.) of a laminate with a thin dense core and then the bonding of this laminate to the base core at somewhat lower pressures. In some cases, the presses used for the latter operation are claimed to be adaptable to applying the diallyl phthalate laminate.

In terms of more specific costs, the diallyl phthalate-impregnated sheets (printed) sell in large orders for about \$0.10/sq. ft.; clear overlay sheets sell for \$0.07/sq. ft. A balancing sheet, usually phenolic-impregnated paper at about 2¢ to 3¢/sq. ft. must be applied to the back half of the laminate to offset warpage. Unlike other high-pressure laminating operations which require a build-up of 3 or 4 balancing sheets, the diallyl phthalate laminate surface can be applied with a backing of as little as two sheets, in some cases only one. It is estimated that direct labor costs when laminating with the diallyl phthalate-impregnated sheets would run about \$0.019/sq. ft. for a two-opening press and about \$0.015/sq. ft. for a 10-opening press. To this must be added an approximate \$0.010/sq. ft. for the costs involved in polishing and maintaining the stainless steel caul plates that are used to impart

created with printed saturated papers



3 The saturated papers are then laid up over the hardboard. In this shuttle press, two boards are pressed back to back. During normal operation, four pieces would be laminated in one press closing. Lay-up sandwich, bottom to top, consists of press pad, stainless steel caul plate, saturated papers, hardboard, cold rolled steel press plate, hardboard, saturated papers, and another caul plate.

4 After the laminating cycle (4½ min. at 340° F. and 150 p.s.i.), the platen is run out and the caul plate is lifted off with a suction device. Finished panels are then run through the flow coater shown in Photo 1, left, only with a different flow head, to apply a strippable vinyl coating which protects the panels during handling, e.g., cutting before panels are glued to suitable core stock.

How clear diallyl phthalate overlay is laminated directly to wood veneer

5 First step in applying a diallyl phthalate laminate to a natural walnut veneer panel often involves toning the surface with a stain. Although oil stains are incompatible with the diallyl phthalate system, water- and alcohol-based stains work quite well. Some laminators, however, do not use stains of any kind. In the panel shown above, only the lefthand side will be laminated; a chest of shelves will be built on righthand side of piece.

a glossy surface to the laminate. Overhead, maintenance of press, etc., will, of course, vary from plant to plant in adding to the total figure. Food Machinery & Chemical Corp. (who supply the diallyl phthalate resin), however, has set an average of 5¢ as the total cost of laminating with its system. Core and veneer costs vary with type of construction desired.

How to apply the resin

The diallyl phthalate resin is supplied to impregnators who coat special papers by first dissolving the resin in solvents, then applying it by roller or dip coating, and finally drying the impregnated paper. The paper stock, of course, can be made available either as a clear overlay or printed in a desired pattern.

The impregnated paper is then supplied to the laminator, who simply lays it up on the core material (which has previously been sanded and wiped clean). When passed through a press, at 300 to 350° F. and from 100 to 250 p.s.i., the diallyl phthalate softens and flows

6 The sprayed pieces are placed on a press plate between canvas pads and the overlay paper is laid on top. At this stage of production, the overlay paper is translucent; it becomes transparent as the heat and pressure in the press liquefy and polymerize the resin.

7 After the saturated paper has been carefully positioned and smoothed, the stainless steel caul plates that will impart the glossy surface to the laminate are applied. The plates are shielded from the press during the actual lamination by larger cold rolled steel press plates.

8 The finished laminate (which eventually consists of the press plate, canvas pad, caul plate, veneered particle board, and the diallyl phthalate-impregnated overlay) is unloaded from the 5-platen press. Temperature is held around 310° F. at 225 p.s.i. Cure time is approximately 10 minutes.

into the surface of the core stock where it progresses to a fully cured resin. The result is a hard, insoluble surface permanently bonded to the core—and with many of the physical and visual characteristics that have made high-pressure decorative laminates so popular in this country. The diallyl phthalate laminate surface offers good chemical resistance (to alcohols, solvents, bleaches, nail polish, iodine, etc.), heat resistance (in a cigarette burn test, the laminate surface withstood the heat for 110 sec. before it started to discolor), abrasion resistance (in the standard NEMA test with a circular abrader, the surface withstood 425 to 450 cycles), resistance to common kitchen scouring powders (diallyl phthalates are slightly superior to other laminates in wet abrasion resistance, slightly inferior in dry), and resistance to crazing (no crazing after 24 hr. at 280° F.). Impact strength, of course, is more a function of the core stock than of the laminate surface.

Applications

Although relatively new to the market, the diallyl phthalate laminate surface has already shown possibilities for home and office furniture, paneling, school desks, counter and dinette tops, and institutional fixtures.

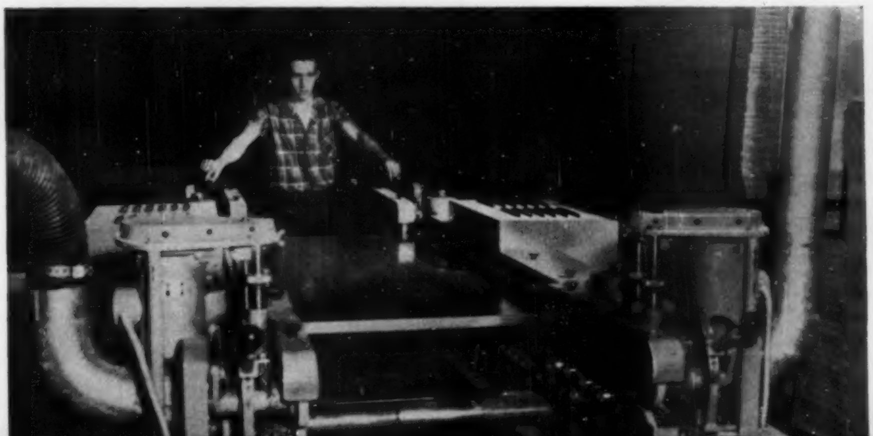
Furniture manufacturers seem to be particularly impressed with the fact that the low pressures involved permit a clear diallyl phthalate-impregnated overlay to be laminated directly to the surface of a wood veneer—both enhancing the appearance of the wood as well as protecting it. Heretofore, most typical high-pressure laminate constructions required the use of printed papers in order to simulate the wood grains.

Diallyl phthalate-impregnated printed papers, of course, are also available to be used in conjunction with a clear overlay to create simulated surfaces. Photos 1 to 4, pp. 90-91, illustrate this technique as applied by Sauder Woodworking Co., Archbold, Ohio, to turn out simulated walnut surface panels to be used for its Foremost line of small tables. The impregnated papers, which are printed in a walnut pattern and also supplied by Riverside Laboratories, Geneva, Ind., are first laminated to the surface of a 3/16-in.-thick hardboard, and the finished laminate, in turn, is then glued to a suitable core stock.

Photos 5 to 9, left and below, illustrate this technique as used by Jasper Wood Products Co., Jasper, Ind., to turn out walnut veneer-topped panels (the veneer is glued to a suitable core stock) to be used in office furniture by Murphy-Miller Inc., and in a line of corner tables and bench-type dividers by Richbilt Mfg. Inc. Saturated paper for the job was supplied by Riverside Laboratories.

It is probably still too early to evaluate diallyl phthalate's total impact on the decorative laminating field. On one end of the furniture price scale—the higher end—the material has opened up new possibilities in making use of natural wood veneers that can now be protected with plastic; at the opposite end of the scale—in the lower and medium price ranges, interest has already been expressed in diallyl phthalate by those furniture manufacturers who previously felt that the costs of other available high-pressure laminating systems put the advantages of the concept out of their reach. There is even the possibility that laminates of this type may now be shaping up as competition for varnish and lacquer finished woods. The potential there alone paints a rosy picture for the future.

Laminating papers for the surfaces in the two applications described above are based on Dapon diallyl phthalate resins that are supplied by the Food Machinery & Chemical Corp., Dapon Dept., Chemicals and Plastics Div., New York, N. Y.—**End**



9 After curing, the panels are edge banded with an IMA machine. The panels are fed into the machine and walnut veneer is automatically glued to the sides. The heat of the banding operation (550° F.) does not damage the heat-resistant surface. Finished panels will be used for office furniture. Other panels go into corner tables and room dividers.

Bright days ahead for

New design concepts, new materials formulations, bring economics of plastic components to application areas where property shortcomings had previously stymied full market penetration

For years the plastics industry has longingly looked at and avidly talked about the fabulous building market; yet despite interest at all levels of the industry, penetration of this market still stands at less than 1 percent.

And the question frequently asked is: "What routes must plastics take in order to capture a larger share of the market?"

Perhaps recent developments in the lighting field may provide some of the answers. In that area, through

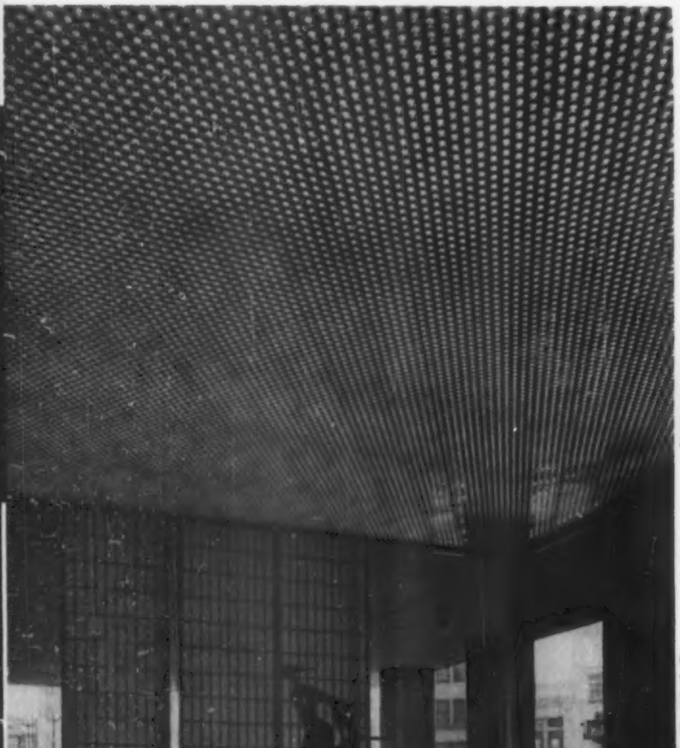
1. material upgrading, and
2. imaginative design thinking

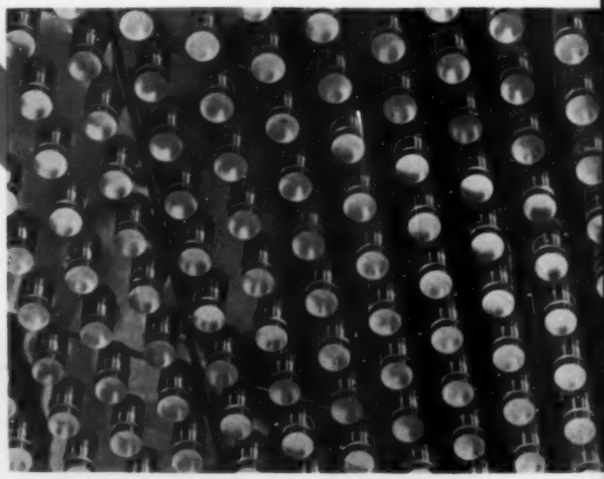
plastics are experiencing a healthy upsurge in several materials.

What's more, the economics are right. For example, the bending of glass into the commonly used lighting shapes can be an expensive proposition, approximately $1.25 per square foot. By comparison, similar shapes can be made of plastic materials for a little less than $1 each.

Material improvements

Plastics for lighting applications have long been recognized as materials that are relatively inexpensive, lightweight, dimensionally stable, fairly resistant to heat, and resistant to breakage in the impact grades. But for many years they have also been known, with certain ex-

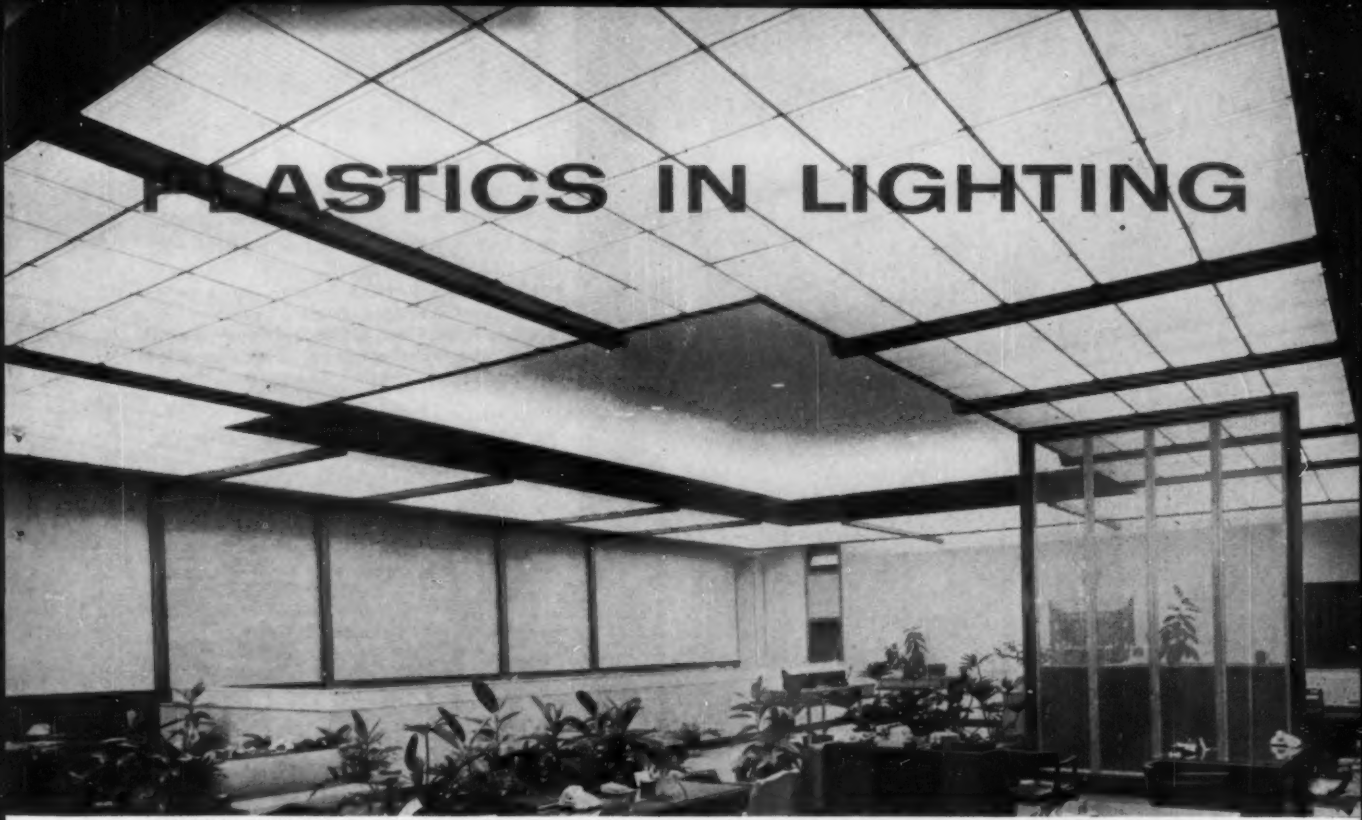




Photos, Cadillac Plastic & Chemical Co.

ACRYLIC LIGHT-DIFFUSING plugs create glistening effect in lobby ceiling of Crown Zellerbach headquarters (at left). Plugs are suspended through holes in polished brass pane. For a close-up of the ceiling, see photograph above.

PLASTICS IN LIGHTING



MODULAR VINYL light-diffusing panels comprise luminous ceiling in bank building. Panels are produced by thermoforming vinyl into "waffle" pattern and bonding flat vinyl sheet to side nearest light source. Panels were produced by Curtis-AllBrite Lighting.

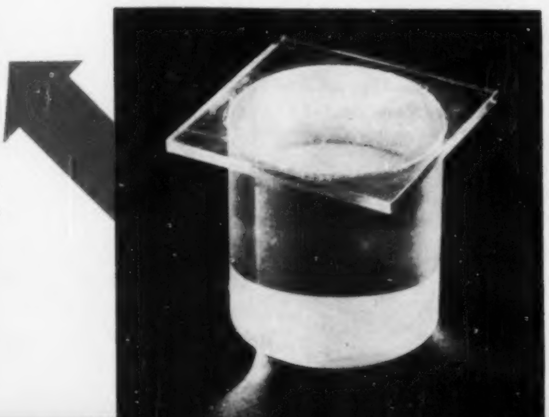
ceptions, as materials with serious yellowing and burning problems.

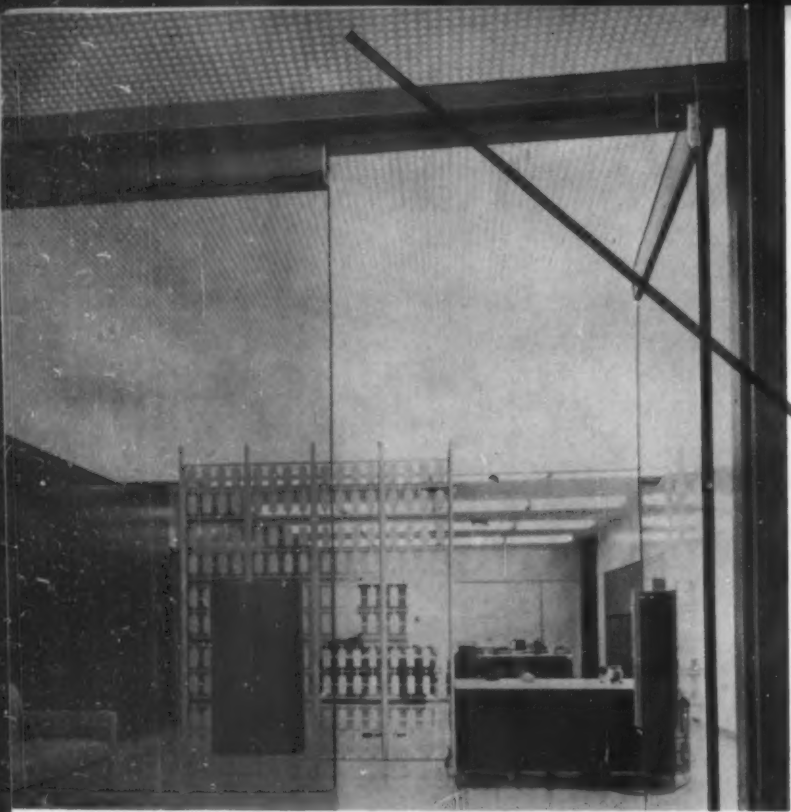
But the picture has changed. Several light-stable polystyrene resins have now been made available by Catalin Corp. of America, Dow Chemical Co., Koppers Co., Inc., and Monsanto Chemical Co. These resins are compounded with ultraviolet absorbers and with antioxidants. Tests have shown that these additives can advance styrene's effective light stability under fluorescent exposure as high as 50,000 hours. In addition, fixtures using the light-stable materials can now be designed much slimmer, down to 1 in. between light source and diffuser. In the past, material suppliers and fixture manufacturers usually recommended a distance of at least 3 in. between these points in order to prevent rapid yellowing of the plastic.

The fact that styrene burns quite readily has prevented more widespread use of the material in luminous ceilings. Most regional and city building codes specify that slow-burning plastic materials, used as light diffusing panels in fixtures mounted flush with the ceiling, shall not exceed 30% of the ceiling area. A step toward overcoming this stumbling block, however, is the recent announcement by Sheffield Plastics Inc., Sheffield, Mass., of a self-extinguishing polystyrene sheet for lighting applications. At this time, little is known of the chemical composition or performance of this material, but its success could push styrene usage to new highs in luminous ceiling systems now dominated by self-extinguishing vinyl. The new material is also light-stable and break resistant. It is extruded from resin supplied by Dow Chemical Co.

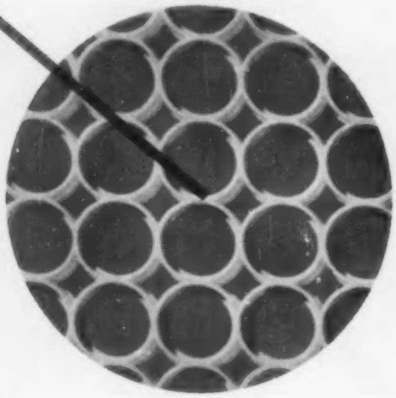
A lot of competition, to vinyl as well as to the new styrene material, could come from the

SINGLE ACRYLIC plug indicates high light-transmitting qualities of material. Flat acrylic square is cemented to bottom of plug to suspend it through brass pan.





POLYSTYRENE PANELS in open louvre pattern make up Infinlite light-diffusing ceiling in office reception room. Floating effect is achieved by use of thin wire and clip hanger suspension system. For close-up of grillework ceiling, see below.



non-combustible urea light-diffusing panels recently introduced by Edwin F. Guth Co., St. Louis. (See "Urea light shields meet fire code," MPl, May 1960, p. 90)

Where color stability under ultraviolet radiation is of prime importance, acrylic is the best material, and it is generally guaranteed for at least 10 years against color deterioration. Acrylic has good dimensional stability, but larger diffusing panels or refracting lens panels are usually designed with ribs or are fabricated in a "dished" pattern to avoid sagging or cold flow. Like styrene, acrylic is a slow-burning plastic, but it can be rendered self-extinguishing in sheet form. There are as yet no acrylic molding powders with self-extinguishing properties. The big drawback with acrylic is that it is expensive, almost twice the price of styrene. Many fixture manufacturers have indicated that they would choose acrylic for practically all of their lighting applications if it were not for the high price!

For application in luminous ceilings and in fixtures covering large areas, vinyl chloride is the preferred material today. It is self-extinguishing, but if plasticizers are used, care must

Table I: Properties of typical lighting materials

Material	Specific Gravity	Light transmission (%)	Color stability[a]	Burning rate (ASTM-D635)	Basic material cost/lb.[b]	Approximate diffuser cost/sq. ft.[c]
Acrylic	1.17-1.20	92	At least 10 years	Slow to self-extinguishing	55¢	60¢-$1.10
Polystyrene (GP-Impact)	0.98-1.10	88-90	5½-6 yrs.	Slow to self-extinguishing	21½¢-28½¢	30¢-60¢
Vinyl Chloride (Rigid)	1.35-1.45	80	5 years	Self-extinguishing	23½¢	15¢-35¢
Glass	2.2	94	Not tested	Non-combustible	—	45¢-$1.00

[a]Fluorescent exposure on stabilized specimens. [b]Uncompounded
[c]Based on 4 sq. ft. flat panels. Greatest cost increase for shapes would occur with glass materials.

be taken in their selection to prevent the lowering of this property. Generally speaking, the material is self-extinguishing if it contains 30% or more of chlorine. As for discoloration, vinyl falls between acrylic and styrene—it is neither as good as the former nor as susceptible as the latter—but it has a tendency to become brittle upon long exposure to heat and ultraviolet light.

The relatively low heat distortion temperatures of the thermoplastics used in lighting, often regarded as a disadvantage, are actually frequently desirable. There are two reasons for this: first, the thermoplastic lighting panel will drop away from the ceiling at temperatures lower than those required to set off a sprinkler system; and second, it is often desirable to have a plastic panel fall away from the ceiling area to floor level, where it might contribute less to the spread of a fire.

For a comparison of properties of acrylic, styrene, vinyl and glass, related to lighting applications, see Table I, left.

New designs in plastic

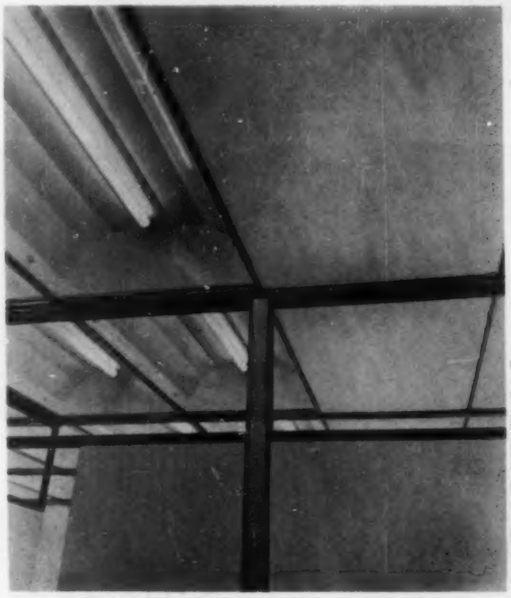
As these improved materials have become increasingly accepted by the lighting industry, competition among fixture manufacturers has largely become a matter of design. By and large, the output of usable light has been increased in these newly-designed fixtures, but in no case has visual comfort been sacrificed.

Fixture design utilizing the prismatic lens has become, in recent years, a popular way of obtaining visual comfort. Not only is glare softened by the prisms, but lighting efficiency is boosted by redirection of light that ordinarily would go to waste. Many manufacturers who produce only diffusing or reflecting equipment for lighting under their own brand, purchase prismatic lenses, such as those injection molded of acrylic by Holophane Co., New York, for use as refracting elements in their fixtures. Lighting units with prismatic lenses of clear styrene have also been recently introduced by The Wakefield Co., Vermillion, Ohio, while the prismatic light shields marketed by The Rotuba Extruders, Brooklyn, N.Y., are extruded from either acrylic or styrene. Rotuba's latest pattern is comprised of hexagonal pyramids, which permit light to enter at any angle from the light source and which diffuse and refract the light toward the intended work area.

Visual comfort through reduction of direct and reflected glare may also be achieved without prismatic lenses or diffusers by the use of flat light panels produced by Owens-Corning Fiberglas Corp., Corning, N.Y. Each panel consists of an acrylic-modified (for light stability) polyester sheet to which thin glass flakes have been added. Light passing through the glass flake to the area directly beneath the fixture is softly and evenly diffused, but much of the glare light entering the panel at a high angle will strike the glass flake, bounce back into the fixture's reflector, and be (To page 190)

Photo, Sheffield Plastics Inc.

CLEAR STYRENE LIGHTING shield is extruded by Sheffield in prismatic pattern for more efficient down-lighting. Translucent styrene sidewalls provide interesting two-tone effect.



Photo, Union Carbide Plastics Co.

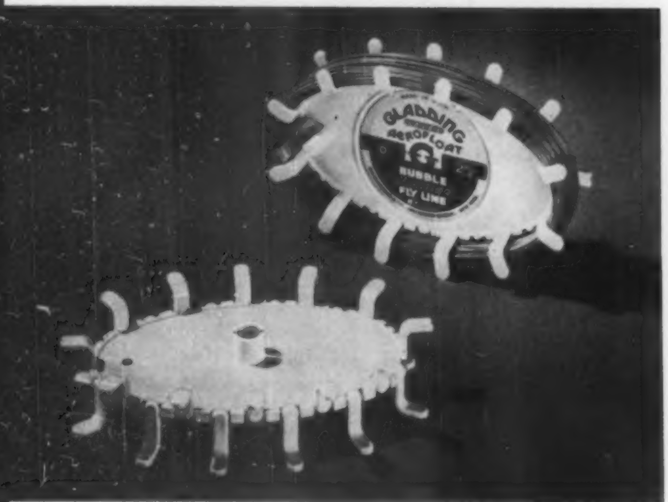
SECTION OF CEILING in new Union Carbide Corp. building. In area at left, vinyl diffusers have been removed to show that ceiling is essentially a series of individually-hung fixtures.

Plastics in the product revolution:

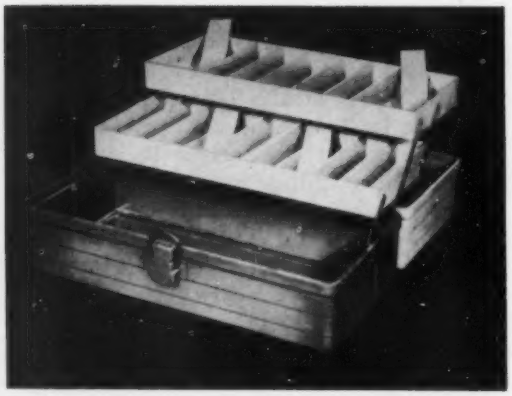
↑ **CLOSED-FACED** spinning reel, Zebco-88, uses Delrin for injection molded back cover, thumb stop, body, tension, and ratchet controls.

FLOATING popper-type lures molded of expandable polystyrene. At bottom is molded, unfinished lure body; top shows completed and decorated popper.

← **HOOK PROTECTORS,** injection molded of polyethylene, keep double and treble fish hooks from tangling in pockets or tackle box. These shields are made by T-Gard, Mattoon, Ill. For actual use of the protectors, see illustration on p. 100.



INJECTION MOLDED polystyrene spool carries floating nylon line, doubles as line storage and transfer medium.



TACKLE BOX, made by Gladding of Grex high-density polyethylene, is 14 in. long, 7 in. wide, 6 in. high.

FISHING TACKLE

Perhaps in no other industry's products have so great a variety of plastics been applied as extensively as they have in fishing tackle. There are between 35 and 40 million anglers in the United States today, and they use a lot of equipment. While this equipment is relatively lightweight, it does consume a sizable amount of various resins.

Estimates on polyester resin consumption for rods of all types range from 600,000 to 1.5 million lb. per year (about 95% of all rods are now made of glass-reinforced polyester).

About a million lb. of Dacron and nylon go into fishing lines, and 1.6 million lb. of various plastics to package them. Lures consume perhaps another 250,000 lb. yearly.

While these poundages are not overwhelming, they represent a wide range of materials and applications.

Rods and reels

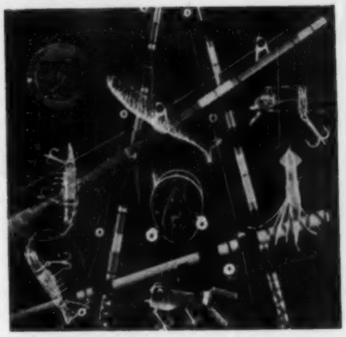
Probably the first use of plastics in fishing rod construction was the use by the Orvis Co. (Manchester, Vt.) of phenolic resin to impregnate Tonkin bamboo by immersing it in a solution of resin and curing. This method of construction results in a very fine waterproof rod with improved resiliency and set, but one that is relatively expensive.

To satisfy the mass market's need for a better fishing rod, the glass-reinforced plastics developed. The first rods were solid shafts consisting of oriented glass filaments bonded with polyester or phenolic resins. They were practically unbreakable and completely waterproof.

However, some of these "glass" rods were too limber for certain purposes, and the tubular fibrous glass reinforced rod was the next rapid development. Such rods have better action, and this construction appears to be the most popular today, although both types are still being made.

In addition to polyesters and phenolics, epoxy resins are now coming into use, and some like the Garcia Conolon rods are using combinations of epoxy resins with nylon flake fillers. Other rod parts made of plastics are listed in the table at right.

One of the first applications of plastics in reels was the use of phenolic molding material for side plates and spools on salt water casting reels. The Penn Fishing Tackle Mfg. Co., Phila-



THE COVER: Fishing tackle, once strictly a wood, metal, and cork affair, as symbolized by the old wooden reel in the upper left hand corner, has turned to plastics for almost every item of equipment. Products courtesy of Abercrombie & Fitch Co.

Use of plastics in fishing tackle

Item	*Plastic used*
Fishing rods and handles	Phenolic Polyester Epoxy Cellulose acetate butyrate Polyethylene Nylon
Fishing line	Nylon Dacron Plastic foams
Reels and parts	Nylon Delrin Phenolics Cellulose acetate Cellulose acetate butyrate Alkyds Polystyrene
Lures	Nylon Cellulose acetate butyrate Vinyl Styrene foam
Tackle boxes	Impact styrene High-density polyethylene Fibrous glass laminates
Bait and lure containers	Polystyrene Foam polystyrene Polyethylene Cellulose acetate butyrate Polypropylene
Clothing (waders, rain gear, insulated underwear, boot liners)	Vinyl sheet Urethane foam Dacron Nylon
Floats or bobbers	Polystyrene Cellulose acetate butyrate
Packaging	Polyethylene Polystyrene Cellulose acetate Cellulose acetate butyrate

delphia, Pa., reports that it has been using phenolics in this application for over 25 years. Other plastic casting reel (revolving spool) parts are acetate and styrene knobs on the handles of reels.

Nylon and Delrin gears are also used in many reels. For example, the closed face spinning reel made by the Zebco Co., Tulsa, Okla., uses Delrin for the injection molded back cover, thumb stop, body, tension, and ratchet controls (see photo, p. 98).

Fly reels, such as the Pflueger Medalist, use injection molded handles, axle caps, spool spacers, and laminated phenolic drag brakes. One fly reel is made of nylon material.

Lines and leaders

In this vital item of tackle, plastics have just about applied the *coup de grâce* to all other materials. Chief materials used in fishing line today are nylon and polyethylene terephthalate (Dacron). Also used are the various plastic line finishes on fly lines and Platyl (Garcia Co.), whose exact compositions are closely guarded trade secrets but which consist of various plastic formulations.

The use of plastics has largely eliminated many of the shortcomings of earlier linen and silk lines (rot, moisture absorption, and visibility, as well as the need for dressings in order to produce floatability).

Since the nylon monofilament itself is nearly transparent it is essentially invisible in the water, a big factor in luring fish to the bait. So good are the invisibility and other properties of nylon monofilament that it has also completely obsoleted cat-gut for leader material; the latter required long periods of soaking in water before it was usable. Also gone is the need for drying the line after use in order to prevent rot.

Another significant advance in fishing line was the unsinkable dry fly fishing line. Available from B. F. Gladding & Co. Inc., Scientific Anglers Inc., Western Fishing Line Co., and others, these lines have a braided nylon core around which is placed a foamed plastic finish, so that the density is less than water.

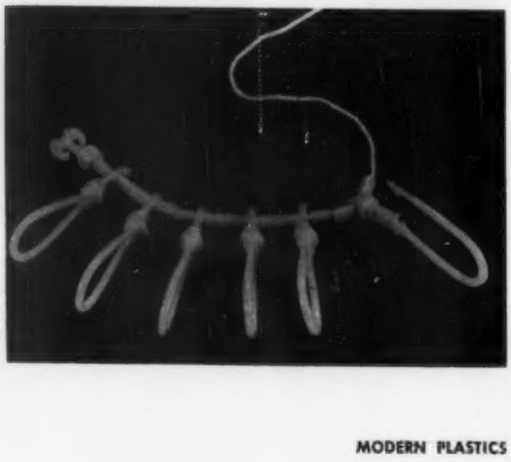
Lures

Just after World War II, most artificial baits and lures (plugs, poppers) were made of wood, metal, or cork with a lacquered finish which had a tendency to flake off with use.

Today, injection molded butyrate has almost completely replaced wood in fishing plug bodies. Butyrate is favored because of its outdoor weather resistance and its ability to be decorated with solvent-type lacquers (see photo, below left). Being naturally transparent, some hollow butyrate plug bodies are painted on the inside with silver and other finishes which closely approximate the sheen of the natural bait fishes that are being imitated. And in addition, hooks can be more firmly anchored. Floating, popper-type (To page 197)

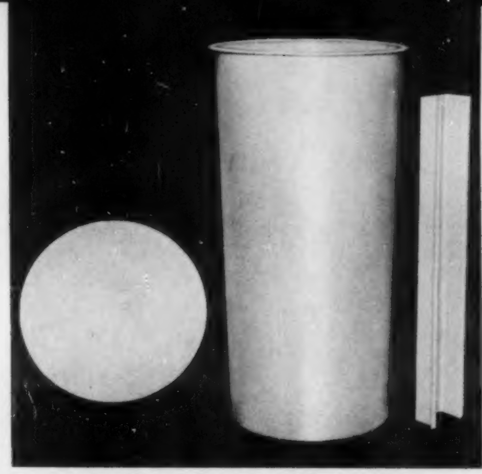
BUTYRATE PLUG (right) is decorated with solvent-type lacquer. Note hook protector, shown in close-up on p. 98. Crayfish at left is molded of vinyl plastisol.

FISH STRINGER has all parts made of nylon resin, including the cord, injection molded hooks, and slide locks to close the hook, molded cord terminals, and short sections of nylon tubing which act as hook separators. In this application, the use of plastic has eliminated corrosion problems.



Switch from steel to polyester cuts tank cost 25%

How 4-ft. component for home water softening system, molded in matched metal dies of glass-reinforced bisphenol-A polyester, licks corrosion problem, saves money, too



COMPONENTS OF BRINE TANK, left to right: cover, tank, float guard. Made of reinforced plastics, tank is lower in cost and higher in quality than previously used steel tanks.

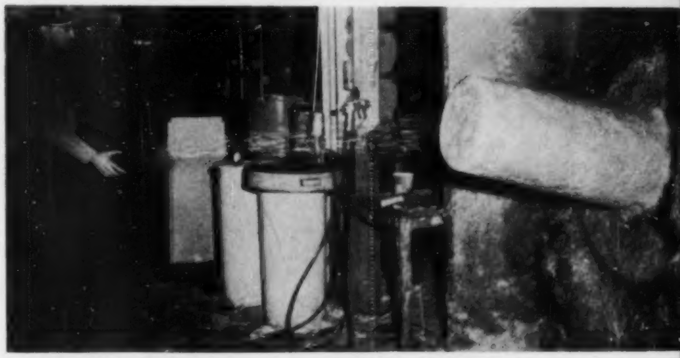
The story of how Borgerud Mfg. Co., Deerfield, Wis., distributors of Water-King home water softening systems, was able to effect significant economies in going from steel to reinforced plastics for the brine tanks used in its installations is easily told.

The basic water softening system consists of an ion-exchange tank and the brine tank which holds 20 gal. of water and 200 lb. of block salt. This solution is used to regenerate the exchange material. Here are the comparative costs for steel and plastics:

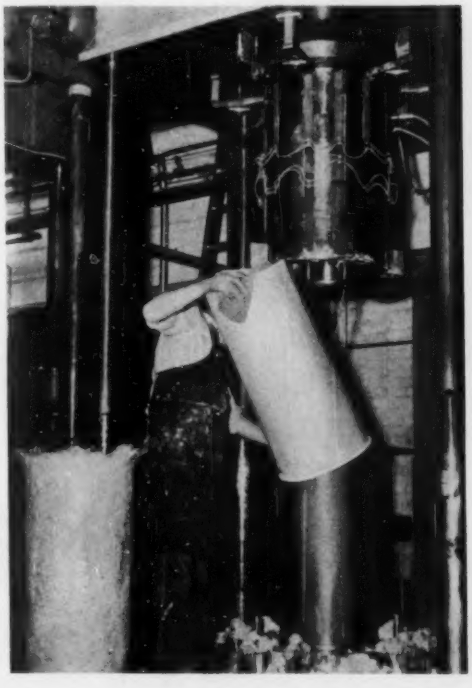
	Polyester	*Steel*
Cost of tank to Borgerud	\$9.37	\$9.30
Buffing	——	1.00
Painting	——	1.00
Bitumsatic tank liner	——	0.75
Shipping	0.26	0.88
Total cost	**\$9.63**	**\$12.93**

Not only were manufacturing costs reduced, but the product was also improved.

First, the corrosion problem was eliminated. The original steel tanks were attacked by the brine solution through pin holes in the enameled lining and cracks resulting from mishandling during installation and use. This necessitated replacements which were both costly and inconvenient. Second, (To page 194)



PREFORM FOR TANK is made on open-type unit. Operator applies chopped glass to screen where it is held in place by vacuum. Polyester is later applied so that preform can be handled.



MOLDED PART is removed from male die. Removal is facilitated by an air jet through bottom of die. Following deflashing, part is ready for shipment. Preform awaiting molding is shown at left of operator.

NOW AVAILABLE FROM NEW PLANT...

SANTICIZER® 409

compare benefits with any other polymeric plasticizer

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Monsanto's new multimillion-lb./year plant producing SANTICIZER 409 is now coming onstream at Everett, Mass. Production was multiplied in response to rapid acceptance of this versatile plasticizer by the plastics industry.

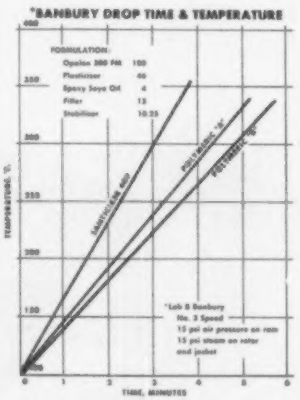
IMPROVED PERMANENCE

SANTICIZER 409 is highly compatible and imparts good performance properties to vinyls. Volatility is low. Heat stability and light stability are excellent. Comparative tests show that SANTICIZER 409 resists solvent extraction best of all lower-cost polymeric plasticizers. SANTICIZER 409 *stays put*, won't exude even in high humidity.

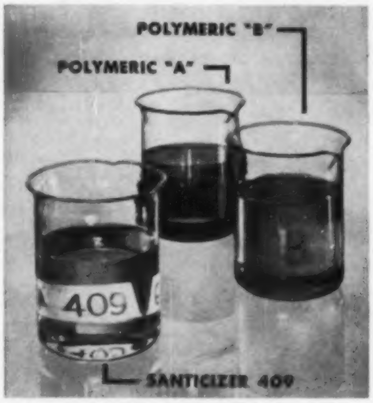
FASTER PROCESSING

SANTICIZER 409 has low viscosity, high solvency . . . for much faster fusion and extrusion. Helps prevent pinholes, "fisheyes," and roughness. You can count on SANTICIZER 409 to boost output, reduce processing problems, and assure optimum physical properties *within your processing-temperature range.*

FAST FUSION



OPTIMUM CLARITY



HIGH PURITY

SANTICIZER 409 is clear, non-hazy, light-colored. Contains no flocculent matter that might weaken electrical properties or cause spotting in thin films and transparent sheeting. SANTICIZER 409 adds no odor to gaskets or wire insulation for refrigerators or other low-odor applications.

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Compare prices and specific gravities. SANTICIZER 409 gives compounders more plasticizer per dollar . . . *more profit per unit volume of compound.* And easier, quicker processing provides added savings.

A guide to winding—Part 1

A properly wound, neat, and attractive roll of film can bring added profits. Here are the engineering principles involved and the major items of equipment needed to do the job right

By Stewart F. Oakes† and Alfred A. Arterton‡

Once regarded as merely a necessary evil, winding is now recognized as an important process in its own right. Whether as an in-line stage or a final operation, modern winding must contribute to efficiency and economy. As a terminal step, it must also contribute sales values. A properly wound, neat and attractive roll of film made on an efficient winding unit is in itself a sales aid which adds prestige to a film product, renders it competitive, and can even increase profits.

In this article the engineering principles concerned in winding plastic film or sheet produced by the most prevalent processes—extrusion, extrusion laminating, calendering, casting — are discussed. General principles, winding drives, winding machines, and auxiliary equipment are described. Also included are numerical examples illustrating how to calculate your requirements, and how to select your equipment.

Unwinding is an allied process, but it will not be discussed here. Generally, the problems of unwinding are the same as those of winding, but the drives involved are quite different.

The first step in analyzing winding equipment requirements is to consider the processing properties of the material to be wound, the dimension of the film web (width and thickness) to be handled, the finished roll diameter that is desired, and the variety of problems which may be involved in the processing of any specific material.

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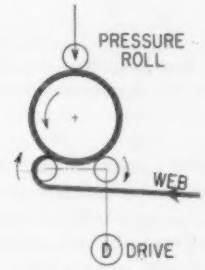


FIG. 1: Schematic diagram showing the principle of surface winding. Torque is applied to driving rolls.

Table I: Some processes and materials on which tension control may be required

Process	*Typical materials*	*Form presented for handling*	*Poss. intermed. process b/f winding*
Extrusion A. Blown B. Lip die extruded	Polyethylene, oriented styrene, acrylic, acetate, butyrate	A. Tube: layflat, gusseted B. Film or sheet	Surface treatment Edge trim Perforating Slitting
Extrusion laminating	Polyethylene on paper, foil, other plastic films	Film + substrate	Trimming Slitting
Calendering	Vinyl, polystyrene	Film or sheet	Cooling Trimming, slitting
Casting	Cellophane, PVA	Film or sheet	Trimming

Table I, at left, summarizes several familiar plastic film processes, generally indicates the form of web usually handled, and lists possible intermediate stages which may be readily included in the production set-up line prior to winding the web.

Web tension

If the winding operation is a success, the finished roll or package of film will have firmness, straight unwrinkled edges, and be

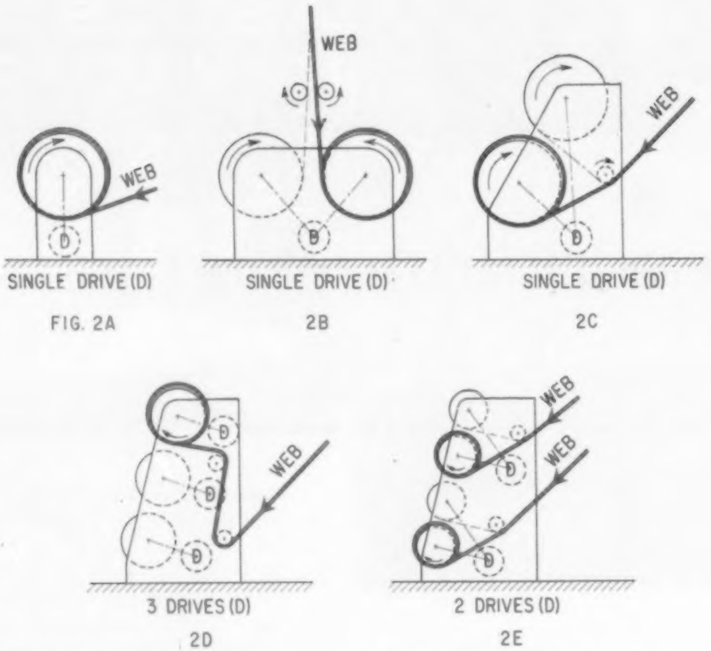


FIG. 2: Schematic diagrams of center winding machines. Torque is applied to the roll being wound. Drawing A is a single shaft machine; B is a horizontal 2-shaft machine; C is a staggered 2-shaft machine; D is a staggered 3-shaft machine with individual drives for each shaft; and E is a staggered 4-shaft machine.

in such condition that film can be handled efficiently in secondary processes which utilize the film or web. In order to produce such a roll, tension must be used in the winding of the film. The amount of tension to be used is a key decision. If proper amount of tension is not used, a wound roll of film may initially appear to be acceptable; however, after a few days of storage in the warehouse, stresses and deformations will probably show up in starred ends and hard spots.

Tension and stretchability

The amount of tension to be used is dependent on the stretchability of the film to be wound. Stretchability, in turn, is dependent on the film's width, thickness, and material characteristics (such as plasticizer used, amount of rigidity, and so on).

Elasticity is especially bothersome when handling thin films. The greater the elasticity, the nearer to zero tension you must wind; otherwise, the memory return of a stretchable film which has been wound with too much tension will result in roll defects.

The total tension to be applied is directly proportional to the lineal width of the web. The size of the winding drive will depend on the total amount of tension (TT) to be delivered at a certain speed. Total tension to be applied is calculated by multiplying the allowable tension, in pounds per lineal inch of width, by the total width of the web. The tension in pounds per lineal inch for different films is usually either derived from laboratory tests or estimated from long experience. Tension used in actual production ranges all the way from 1 to 2 oz./in. of width for soft, stretchy plastics, up to 2 to 3 lb./in. of width for heavier, more rigid plastics.

Web width and thickness

Total width is also a factor in winding. Very narrow webs are difficult to handle, and so are very wide webs; intermediate widths are somewhat easier. Laminated webs, it should be noted, take on the characteristics of the substrate, so that in winding a paper web laminated to thin plastic film, the thick, wide web which the paper substrate presents will be the governing factor in determining tension to be used. Web thickness and the web width to be handled are interrelated, and the problems they involve are similar. Very heavy sheet is generally not wound on rolls. Table II, below, indicates limits of film thicknesses which can be practically wound.

Because of stretchability as well as other factors, surface winding is not practical for thin film. However thin film can be handled by center winding, and the problem of stretchability can be considerably minimized if:

1) Guide roll spacing does not exceed 30 in. and all rolls are balanced, to avoid introducing wrinkles due to improper tension.

2) All rolls are driven, to reduce friction and drag.

3) Speed regulation in the process is exact and web gage variations in the die are closely controlled below 5 percent.

4) Wrinkle eliminating rolls are as close as possible before the winding station.

5) Trim take-off is properly tensioned in order to avoid the occurrence of web wrinkles.

6) Web winding controls are essentially friction-free, i.e., frictionless dancer rolls, or use of a torque-sensitive motor.

In winding thick sheet, the problems are not as critical. Center winding is usually preferable with heavy sheet to prevent scratching of the material, and to wind a firm roll that will not telescope due to the slippery nature of the material; however, under some conditions surface

Table II: Limits of film thicknesses between which film can be handled by winding.

Type of film	*Range* in.
Soft or flexible film	
Extruded blown film	0.0005 to 0.020
Lip die sheet	0.0020 to 0.080
Cast film	0.0080 to 0.010
Calendered film	0.0002 to 0.080
Rigid films	
Extruded or calendered	0.001 to 0.040

winding may be possible. Other factors to be taken into account when winding heavy sheet are to include the following:

1) Gage variations should be minimized using proper temperature control on casting rolls when the film is formed.

2) Film speed must be accurately controlled and regulated in the entire winding unit.

3) Core size must be large enough to prevent "setting" the sheet so that it will not retain curl when unwound.

In winding wide webs, a special problem is the prevention of winding shaft deflection. The wider the span of the material, the more necessary it is that the shafts are sufficiently rigid, so that they will not sag under their own weight and the weight of wound film, causing wrinkles.

Size of the winding unit—including size and rigidity of the core—is dictated by the size of the web to be wound. The wider the web, of course, the greater the risk of gage variations, wrinkling, and other defects. Normally, the practical limits of the web width appear to be about 5 to 108 niches.

Table III: Range of speeds commonly used in plastic web processes, ft./min.

Extrusion[a]	
Blown film	3 to 300
Lip die extruded film	50 to 600
Extrusion laminating	100 to 1500
Calendering	50 to 250
Casting	100 to 1000

[a]Dictated by extrusion speed.

Roll and core diameter

The diameter of the finished roll that can be made is usually determined by the type of the winder that is available, keeping in mind that a build-up ratio of 1 to 12 is the outside limit. Expressed as 12:1, this is the ratio of maximum wound roll diameter to outer core diameter. In actual practice, build-up ratios generally range from 4:1 to 12:1, according to the type of winding drive that is selected.

For all types of film under discussion, practical core sizes range from 3 to 15 in. O. D., with most processors favoring the 3-to-10-in. range. The larger the core diameter, the better the control, because control depends on the build-up ratio which decreases with increasing core diameter.

Another major decision to be made is how much material should be wound on a given core size. The vast majority of processors have been sold, or have sold themselves, on use of a 3-in. core to increase the amount of material per 12-in. roll. In winding a finished roll with a total O.D. of 12 in., the build-up ratio using a 3-in. core is 12:3, properly expressed 4:1; use of a 4-in. core results in a build-up ratio of 3:1. Using the larger diameter core would make small difference in the amount of material wound on the roll, but would also result in better winding control and lower equipment cost. It can be proved that the use of a core slightly larger than the 3-in. core (now in almost universal use) could save industry hundreds of thousands of dollars in equipment and operating costs.

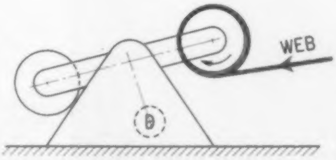
In any case the core, of whatever diameter, should be as rigid and light in weight as is practically possible to use. Tubular core materials range from hard cardboard with steel ends, through aluminum and steel. Each winding job may require a different type of core to meet the requirements of "the most rigid and lightest weight core to do the job." Therefore, the proper choice of a core material is dependent on the circumstances involved.

It is also important in winding that material is wound on the core with the right "set," achieved by proper control of web processing temperature. By this we mean that the material should be delivered for winding in a condition as close as possible to the physical condition in which it will remain, that is, stabilized as nearly as possible as to gage, temperature, etc.

Coordinating winding

To ensure that material comes to the winder at constant speed, in a stable state, with minimum gage variation, the winding machine is coordinated with the film processing equipment by means of haul-off equipment. This usually includes the necessary drive rolls and drives, slitting equipment, cooling or heating equipment, bubble collapsers, trim removal units, surface treatment equipment, cooling baths, wrinkle eliminating equipment. These are all assembled in framing that suits the various types of processes. In all the processes described below, edge trimming, slitting and draw down are included as intermediate operations prior to winding. According to the process, winding must be co-ordinated with the film production process used, as shown in the following:

Extrusion: In blown film the winding equipment is co-ordinated with the tower take-off. In the tower, the bubble of film from the extruder is collapsed by converging rolls and pinch rolls. The speed of the pinch rolls is integrated with the output of the extruder and is synchronized with the winding equipment. Sometimes the film is slit and surface treated before it is wound; this latter equipment **(To page 110)**



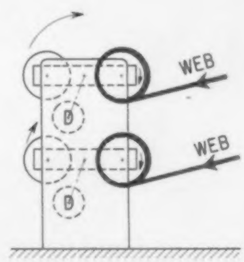
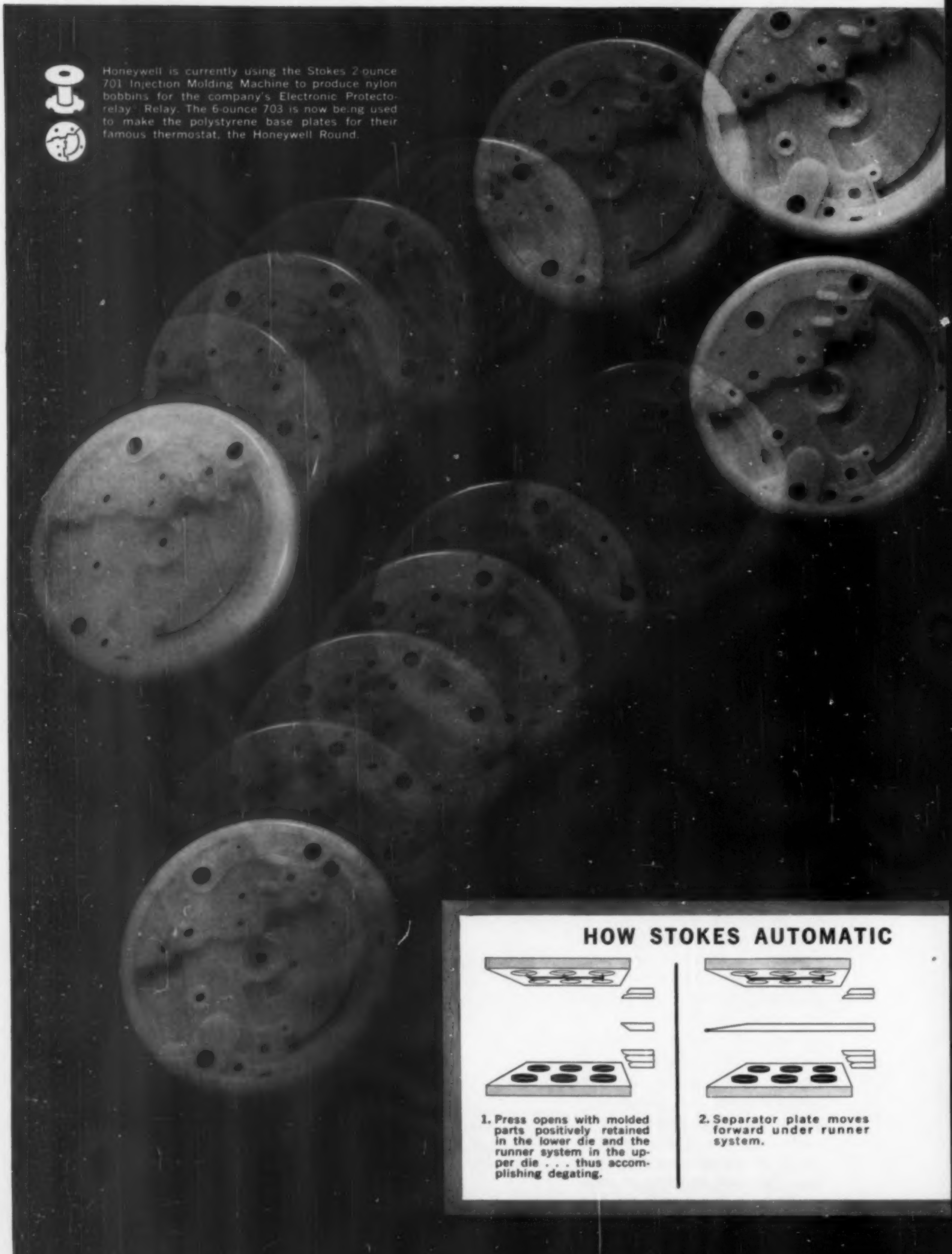


FIG. 3: Drawing A shows the layout of a 2-shaft turret winder. In higher speed winding operations, 4-shaft twin turret machines are used, as shown by Drawing B.


Honeywell is currently using the Stokes 2-ounce 701 Injection Molding Machine to produce nylon bobbins for the company's Electronic Protecto-relay Relay. The 6-ounce 703 is now being used to make the polystyrene base plates for their famous thermostat, the Honeywell Round.
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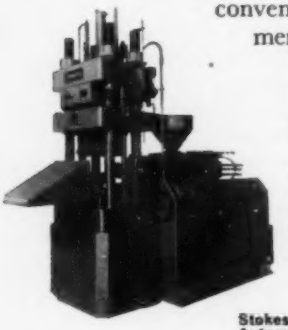
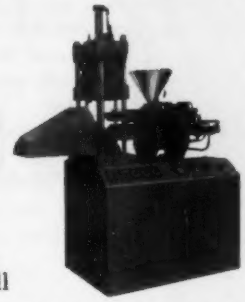


Stokes 6-ounce 703 Automatic Injection Molding Machine



Stokes 2-ounce 701 Automatic Injection Molding Machine

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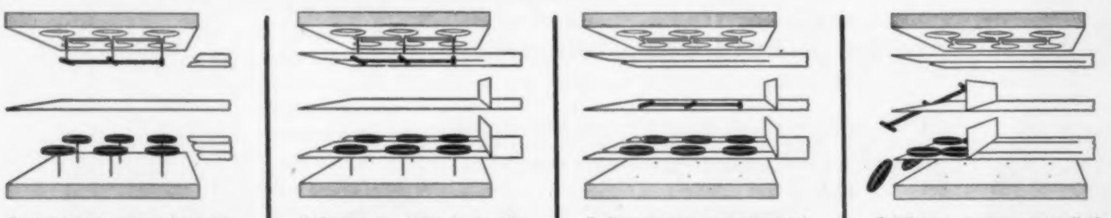

3. Knock-out pins eject the parts and runner system.

4. Separate slotted combs for parts and runners move forward into stripping position.

5. Ejector pins are retracted, stripping parts and runner system. Parts remain on lower comb and runner system falls on separator plate.

6. Wipers assure controlled removal of parts from comb and runners from separator plate into separate chutes.

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is also synchronized with the winding equipment.

In lip die extruded film the film is cast onto highly polished rolls, provided with a drive co-ordinated with the output of the extruder. The speed of the winding machine is synchronized in turn with the speed of these rolls.

Extrusion laminating: The material goes through a set of chill rolls which are synchronized with the laminating rolls, and these rolls in turn are synchronized with the winding machine.

Calendering: The material is cooled or heated by highly polished rolls which are synchronized with the speed of the calendering. In addition, these polished rolls are synchronized to the winding machine.

Casting: A set of casting rolls or a casting conveyor is involved in the casting process. The material is cooled on another set of rolls synchronized with the casting roller conveyor speed, and the winding machine is synchronized in turn with the operating speed of these rolls.

As noted, speed of the web being delivered for winding in all processes, should be constant. General speed ranges used in the various processes are shown in Table III, p. 107.

Having surveyed the general problems involved in the winding of plastics, the types of controlled tension drives and machines that are available to do the winding job will be considered.

Drives

Two types of drives are generally used, mechanical and electrical. At present there are probably more mechanical drives than electrical drives in the field because of the low initial cost of the mechanical drive. It is also fairly easy to synchronize with preceding processes. There is, however, a growing trend toward the use of electrical drives on most new equipment because of their greater flexibility and accuracy in controlling tension. Another factor favoring the electrical drive is that mechanical drives often involve costly maintenance, and are less dependable.

Among the types of electrical drives available, the direct-current type is often used. It usually consists of a shunt wound d.-c. motor with field and/or armature control. There has also been some use of series wound d.-c. motors with a special motor characteristic control, and a speed limiting device to prevent its "running away" under no load in the event there is any web breakage.

If an a.-c. type motor drive is used, it must be either a torque-sensitive unit or consist of an a.-c. motor coupled with an eddy clutch. Over all, experience with multiple installations indicates that the d.-c. motor drive is the preferred type since it currently provides the widest range of control available with respect to speed, tension, and accuracy.

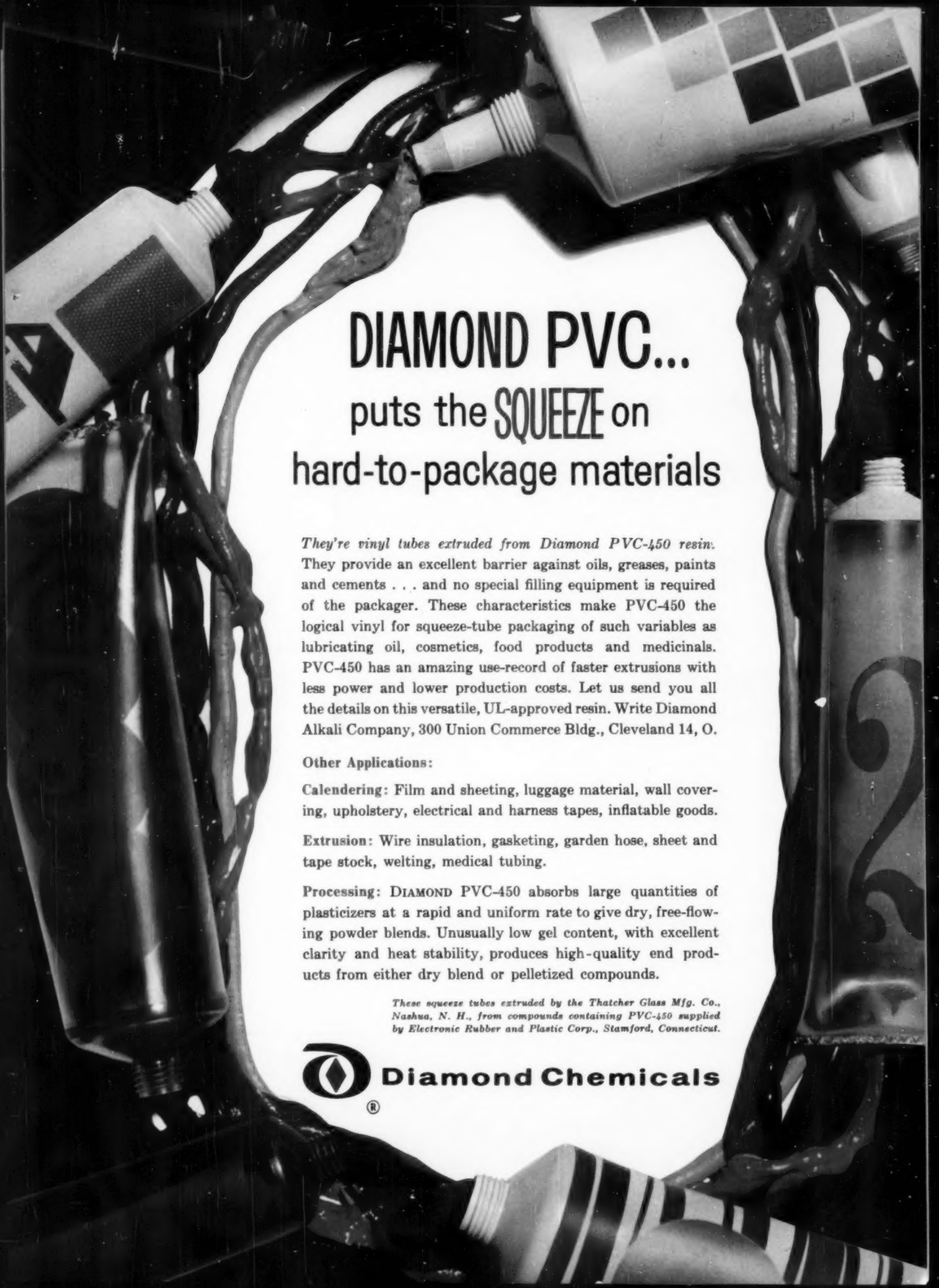
To control speed on the newer torque-sensitive a.-c. and d.-c. drives, various types of feed back control are used. To provide the feed back, instrumentation and sensors include dancer rolls, rider rolls, servo-motors, and tachometer generators, coupled with the motor control.

In Table IV, left, is a comprehensive summary of the types of controlled tension drives and winding machines from which a drive can be chosen to suit the winding requirements of most materials and processes. After an analysis of the web material and process to be used, and after such key variables **(To page 195)**

Table IV: Available types of controlled tension drives and winding machines

Type	*Build-up ratio*[a]	*Tension ratio*[b]	*Characteristics*	*Control accuracy*[c] %	*Power efficiency*[e] %
Friction clutches					
Manual control	4:1	8:1	Constant torque	[d]	10 to 15
Automatic control	8:1	10:1	Approx. constant h.p.	±10	40
Eddy current clutches					
Automatic control	6:1	10:1	Approx. constant h.p. to tapered tension	±5	15 to 20
Variable speed drive					
Mechanical	5:1	6:1	Constant h.p.	±5	65 to 70
Hydraulic	8:1	10:1	Constant h.p.	±5	60 to 65
Hydraulic coupling	4:1	—	Increasing torque	—	20 to 25
Hydraulic loaded					
Differential	6:1	6:1	Increasing torque	±15	10 to 15
With automatic control	10:1	10:1	Constant h.p. and tapered tension	±5	25
A.C. torque sensitive motors	6:1	10:1	Approx. constant h.p. to tapered tension	±10	20 to 35
D.C. motor drives					
controlled by dancer roll	8:1	20:1	Constant h.p.	±5	25 to 30
Controlled by load	8:1	10:1	Constant h.p. and tapered tension	±2	65 to 70

[a] Diameter build-up ratio is ratio of diameter of wound roll to diameter of core. Maximum practical value.
[b] Tension ratio is total maximum tension that is going to be applied, in proportion to the total minimum tension that is going to be applied. Maximum practical value; a value in excess of this figure will be difficult to control, probably, and unduly expensive.
[c] Plus or minus. Variation from the desired torque-speed characteristic.
[d] Dependent on operator.
[e] Power output vs. input at maximum roll build-up. Used to calculate how much power will be needed for the winding machine, if winding drive is to be synchronized with main drive; indicates whether enough horsepower remains in the main drive to run the winding drive, or more must be supplied.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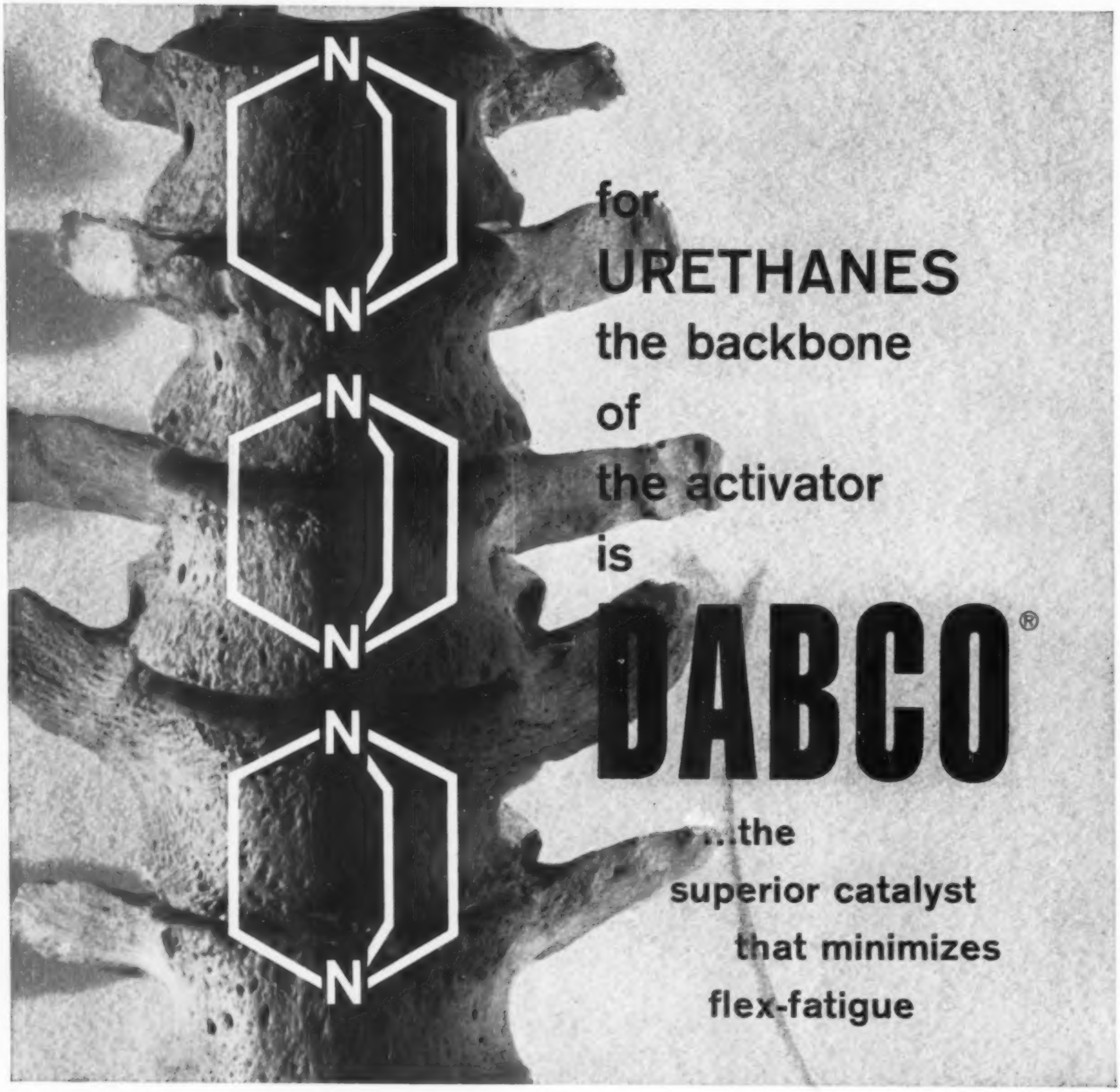

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Field erection of plastic shelters

By Anthony F. Gurdo*, Joseph M. Schramp*, John E. McCormick*, and George J. Stabler*

Efforts in developing a technique for on-the-site field fabrication of rigid reinforced plastics shelters for housing personnel and/or electronic gear, using recently developed equipment and processes are discussed. The techniques involved center around the use of an air-inflatable mold that is made of reinforced Mylar.

Also basic to the technique are a new group of guns which spray resin mix, and glass delivery "guns" which chop (or break) glass roving. The sprayup system projects the resin and chopped strands of glass fibers simultaneously or alternately onto the mold surface. This technique permits the application of thoroughly wetted glass (wetted with catalyzed and promoted resin) quickly and uniformly with a minimum loss of time and material. Sprayup equipment can be assembled into a portable kit. Wherever a man can operate a commercial paint spraying outfit, he can sprayup a laminate of reinforced plastics.

Features covered in this article will include selection of mold and mold materials and erection and rigidizing of same in order to provide a strong enough working surface to withstand spraying up and rolling of the glass-resin materials; choice of resins with regard to sprayability, fire retardancy, weather resistance, etc., and glass with respect to smoothness of feed, cutability, uniformity, and ability to conform to contours; laminate testing to determine compliance with requirements; and stepwise discussion on actual field fabrication of a prototype Quonset-shaped shelter 24 ft. long, 12 ft. wide, and 6 ft. high.

In direct contrast to the pronounced trend in the building industry to shift from site to shop fabrication in order to reduce the amount of man hours and time involved in the erection of buildings, Air Force engineers have been experimenting with the feasibility of on-the-site fabrication of rigid reinforced plastics shelters using recently developed spray-up equipments and techniques.

The purpose of the experimental program was to determine the feasibility and usefulness of such techniques to the military shelter program in terms of logistics and economics. Because of its simplified geometry, the shelter design selected for test was the Quonset (a cylindrical arch with spherical ends). A mathematical structural analysis was performed to determine the physical properties which would be required in the final laminate in order to support the stresses as well as loads encountered in such military field shelters.

Representative conditions used in determining the design of the shelter fabricated at Rome Air Development Center (RADC) are as follows:

Wind loads	87 knots, guyed
	52 knots, unguyed
Snow loads	25 lb./sq. ft.
Ice load	2 in. (measured radially)
Ambient temp.	−55° C. to +71° C.
K factor	0.25

These values will vary with the intended use of the shelters. Based on the analysis it was decided to use an average wall thickness of 0.2 in. for 52 knots unguyed.

The air inflatable mold

For on-site, field spray-up conditions, the ideal mold is one that is very lightweight and easily erected. Furthermore, it should be inexpensive, compatible with spray resins, reusable, and have inherent mold release properties. The latter characteristic insures that the time consuming operation of applying mold release is eliminated. Particular emphasis should be placed upon the service conditions to which the mold will be subjected in use. Rough handling can be expected, i.e., dragged over rough, rocky terrain; trod upon and gouged, pierced by sharp objects, etc., during the course of erections and disassembly cycles.

To decide what material to make the mold with, sample spray-ups of glass-resin laminates were prepared on various film

FIG. 1: Spray-up operation showing gun and method that is used for applying resin-glass mixture.

*Structural Materials Section, Rome Air Dev. Center, Griffiss Air Force Base, N. Y.

Table I: Equipment and materials

Equipment

A. Spray-up equipment consisting of:
1) Two (2) resin spray guns.
2) One (1) glass roving chopper.

B. Generator set—1 each:
110 to 220 v.; 60 cycle, 2.5 kw.

C. Air compressor—1 each:
15 cu. ft./min. air min. @ 75 to 80 p.s.i.

D. Blower motors (fans)—2 each:
Two (2) centrifugal blowers, capable of maintaining minimum of ¼-in. H_2O pressure and delivering enough static pressure to maintain equilibrium.

E. Air inflatable mold:
Shape and size dependent upon structure to be fabricated, material—scrim reinforced Mylar.

F. Hold down ring:
Sectionalized; tubular aluminum, conforming to base contour of mold.

G. Anchoring rods—50 each:
L-shaped steel rods, 18 in. long.

H. Scaffolding—2 each:
Adjustable aluminum bridge scaffolds.

I. Tanks—2 each (same size):
Capacity: 10 gal./min.
Working pressure: 20 p.s.i.
Fittings: Pressure regulator and gage safety and relief valve, air valve, and fluid valve.

J. Hose—2 each per tank (25 ft./min. length):
1) Air hose: Rubber hose suitable for line pressure.
2) Resin hose: PVA-lined hose.

K. Agitator—1 each:
Controllable speed air or electric driven mixer.

L. Graduates: 5-cc., 10-cc., and 100-cc., sizes.

M. Rollers: 50 each:
3-in. and 7-in. Mohair covered.
6 each long handled to increase reach.
25 each trays for holding styrene.

N. Scale—1 each:
Preferably metric system (g.).

O. Shears: 1 each.

P. Miscellaneous tools:
1 each shovel, 1 each mallet.
1 each pick, 1 each cutting tool.

Q. Hinged 55-gal. drum—1 each:
For access chamber

R. Fire extinguisher—1 each (foam).

S. PVA film—1 each, roll:
48 in. width, 10 mils thick.

T. ¾-ton trailer—1 each.

Raw materials

A. Resins—Spray grade.

B. Catalyst—MEK peroxide.

C. Accelerator—Cobalt Napthenate (use only if MEK peroxide system is used.)

D. Styrene.

E. Solvents—Acetone for flushing tanks, resin lines, and cleaning equipment.

F. Glass roving.

materials and elastomeric proofed fabrics without the application of release agents. After the laminates were cured, the mold materials were peeled or stripped by hand. Of these, all-weather Mylar, a cast polyester film made by E. I. du Pont de Nemours & Co. Inc., exhibited best properties in terms of releasability and non-damage to film surface. However, the rip-stop characteristics of Mylar were undesirable. Once a puncture or tear is made, the rip tends to propagate to the extremities of the film. In order to circumvent this, a scrim-reinforced Mylar film, designated as Scotchpak AX-69 and manufactured by Minnesota Mining & Mfg. Co., was selected. The components of the material are a) Type W Mylar; b) nylon scrim reinforcing; and c) extruded polyethylene inner liner. The latter is incorporated to facilitate seaming and joining of gores in the fabrication of structural shapes. Scotchpak AX-69 is calipered at 0.011 in., and exhibits a grab tensile strength of 140 lb./in.

Based on the strength and the weight of the mold material, maximum inflation pressure of the mold was calculated to be approximately 54 in. of H_2O (2.0 p.s.i.), (that is, the specific size and shape mold discussed herein could withstand a maximum of 54 in. of H_2O internal pressure before it would burst). It can then be calculated in terms of weight of uncured resin-glass mix (specific gravity of about 1.65 g./cm^3.) which the mold when inflated to capacity could support before collapsing under the load. This averages out to about 20 in. or 160 lb./ft.^{2} of glass-resin mix, which is decidedly in excess of the requirements for the shelter which was fabricated.

The inflatable mold was purchased from the G. T. Schjeldahl Co., Northfield, Minn. Gore seams were bonded with 1-mil G. T. Schjeldahl 300, a Mylar-backed polyester tape, which was applied by heat-sealing techniques. It is necessary to maintain joint strengths at least equal to that of the mold material since the mold is only as sturdy as its seams. Seam tapes were applied only on the interior of the mold so as to eliminate any possible seepage of


Tough Target
Fire globes of tough Tenite Butyrate plastic cut replacement costs for New York City
Here's a good example of how a switch to plastic can improve product performance.
In New York City, orange-colored light globes mounted on nearby poles are used to call attention to the location of fire alarm boxes. However, over the years, vandal breakage of the glass globes had become a growing problem. Four years ago, two of the boroughs found an answer—they switched to globes of Tenite Butyrate plastic. Since then, each broken globe has been replaced with one made of Butyrate. Result: the replacement rate has been cut by as much as 60%. And even this improvement will be bettered in another year when the whole system will have been converted to Butyrate globes.
As in so many other applications, Tenite Butyrate supplied a superior combination of the properties needed...high resistance to impact, weather durability, good moldability and excellent light transmission. Of importance, too, the Tenite Color Laboratory developed a color formulation that duplicated the orange hue of the original glass globes.
Perhaps your company has an outdoor material problem that could be solved by a switch to Tenite Butyrate.
Why not investigate this tough, durable plastic? For information, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENN.
TENITE®
BUTYRATE
an Eastman plastic
Fire globes molded of Tenite Butyrate by A. L. Hyde Co., Grenloch, N. J., for The Welsbach Corporation, Philadelphia 2, Pa., which does street lighting maintenance for the City of New York. Commenting on the considerable reduction in replacements since switching to Butyrate, Welsbach's New York City manager says, "Butyrate's resistance to shock is so great that no replacement is necessary when the globes are pierced by BB shot or even small bullets. They resist damage from small stones, and even large rocks will only tear the Butyrate, leaving the globe in serviceable condition."

Table II: Physical properties of sprayed fibrous glass

	Ultimate strength	Modulus of elasticity
Before Weatherometer		
	p.s.i.	*p.s.i.*
Tension	13,300	0.23×10^6
Compression	20,400	—
Flexure	20,900	0.61×10^6
After 500-hr. Weatherometer		
Tension	11,300	0.20×10^6
Compression	16,500	—
Flexure	17,200	0.56×10^6

resin beneath them. Otherwise, after cure of the mix and removal of mold, there would probably be a tendency to tear or strip off the tape seams with the cured resin.

For mounting and anchoring purposes, the mold was designed with a skirt 12 in. wide around the periphery of the bottom. The skirt was reinforced with several strips of Scotchpak tape. This was necessary because of the non-uniformity of the tie down arrangement which set up points of stress concentration in the material at each anchor location.

The mold need not be perfectly airtight. In fact, once erected as long as rate of escaping air is equal to or less than incoming air, an equilibrium is maintained and the mold remains erect.

Field equipment

The spray-up equipment used in the fabrication of the shelter was an early model of the Rand Fiber-Resin Depositor, manufactured by the Rand Development Corp.[1] (Fig. 1, p. 113). Other guns would probably work as well. In addition to the spray-up equipment, the "kit" used in the fabrication process was assembled with equipment available in the laboratory. The chief problem was to assemble an equipment system which would be completely independent of outside or commercial power. A list of equipment and materials is shown in Table I, p. 114. The Generator Set was used to provide all the power needed to operate the blower motors for inflating the mold, the glass delivery guns, and the air compressor for the resin spray guns. The supply line pressure must be of sufficient magnitude to provide a minimum of 65 p.s.i. at the spray nozzles under full flow conditions. The compressor was equipped with a 1/2-hp., 110-v., 60-cycle single phase motor and was driven by the B-12 Generator Set.

Resins were delivered to the depositor by means of pressure feed tanks since it was the most practical way of delivering large quantities of material to the spray guns. When the tanks are filled and pressure adjustments made, they keep the guns fully supplied at a constant pressure for greatest speed and uniformity.

Roving and roving chopper

The fibrous glass roving used was standard, commercially available stock. Two types were used: one with a medium soft chrome anti-static binder normally used for preform application, the other with a hard chrome binder with colored tracer, normally used for spraying. The terms "hard" and "soft" refer primarily to the tendency of the individual strands in the roving to either retain their strand integrity (hard) or to open readily so that there is a high degree of filamentation (soft). Apart from the binder with the colored tracer, there was no difference in the two types of roving. Both were fabricated from Type ECG 140 filament, with approximately 60 ends per strand. However, the hard chrome roving with the colored tracer was easier to use. It "wet" better and could be deposited very evenly. Also, there was very little back spray of chopped glass. The soft, anti-static chrome roving was difficult to use in the spray application, as it was hard to obtain consistent thickness in the laminate because of the lack of colored tracer and because of a tendency of the chopped roving to "bunch up" on the mold. Also, the back spray was extremely annoying to the operator. The mechanical strengths of panels fabricated from the two types of roving were very close and should not be considered in the choice of roving.

The chopper is designed so that uniform fiber lengths of ¾, 1½, 2¼, or 4½ in. can be obtained. It was found through prior experimentation in the lab that uniform 1½ in. long fibers did not have a tendency to bunch up as did ¾ in. and shorter length fibers, and they exhibited a more random orientation than fiber **(To page 120)**

[1]The use of the Rand gun is by no means to be construed as an endorsement of that particular equipment by the Air Force—it was used because it was the first with which the authors had become familiar.

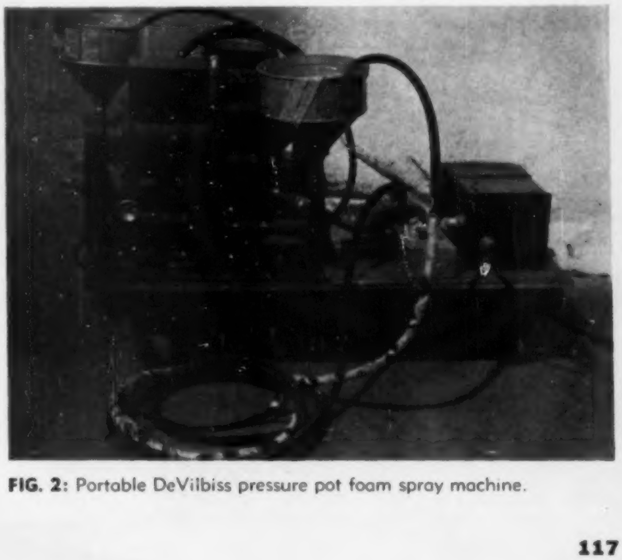

FIG. 2: Portable DeVilbiss pressure pot foam spray machine.

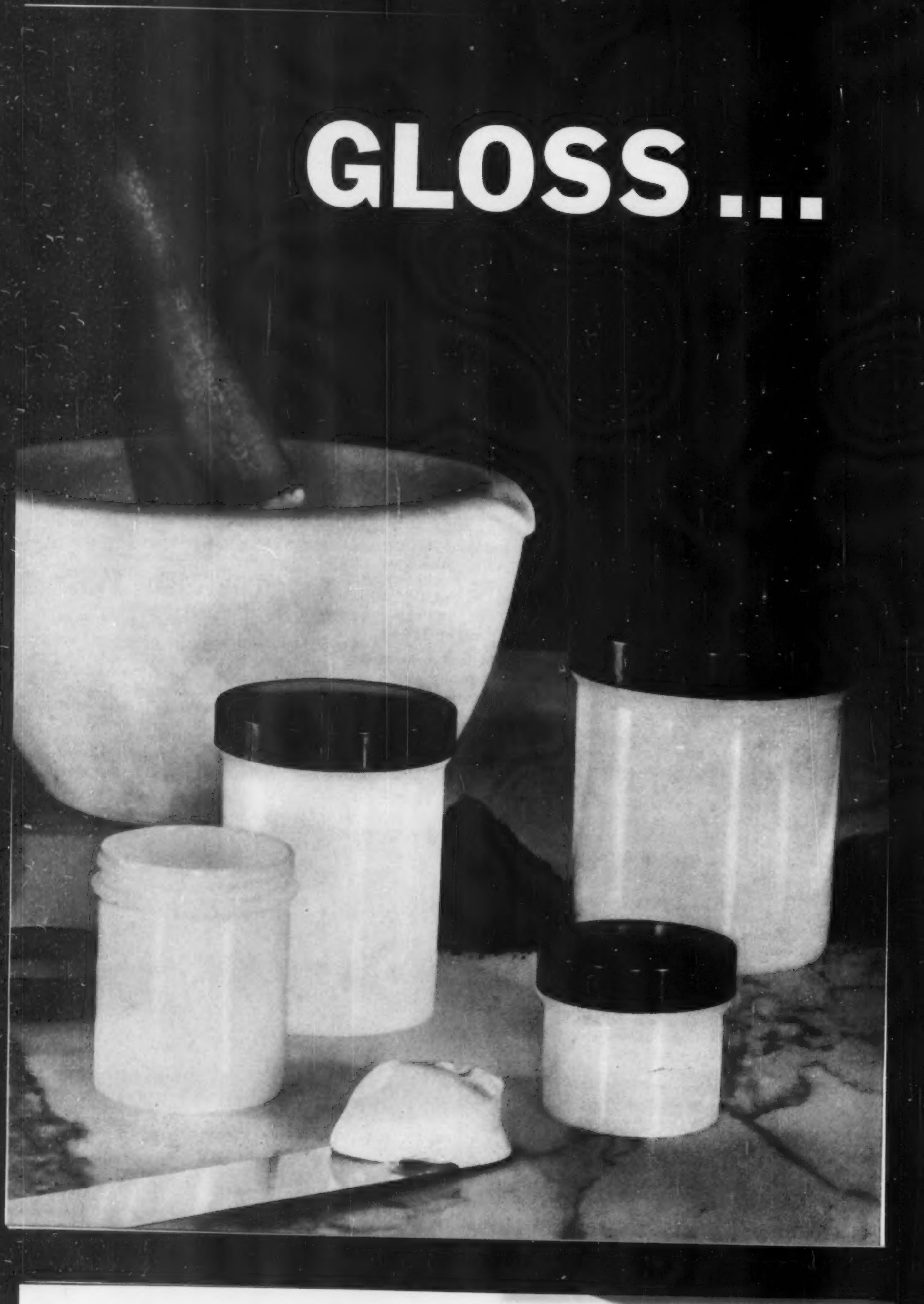
GLOSS...

FIG. 3: Shown at field site are the hold down ring (light pipe at right); air duct (at left near trailer wheel); and 55-gal. drum (only opening visible in foreground), which is used for entrance chamber.

lengths greater in size. More uniform thicknesses and physical properties were also obtained with 1½-in. lengths. The ¾-in. fibers fouled up the glass chopper quite consistently, necessitating frequent dismantling of the chopper assembly which caused considerable loss in time. Small length fibers "floated" more and tended to be misdirected from the spray-up area. Fibers longer than 1½ in. did not fan out enough so that proper wetting was not facilitated and thereby caused resin starved areas in the finished laminate. The chopper was used in conjunction with a Variac, so that variable speeds of glass delivery could be obtained. The delivery rate set with the Variac was such that the chopped roving delivered per unit time equalled the amount of resin delivered by one gun, or, in other words, the roving delivered was equal to one-third the total amount of glass and resin sprayed. Maximum efficiency as well as the ease of handling were achieved with a roving and resin delivery rate of approximately 3 lb./min.

Physical testing

Since the mechanical strengths of laminates were unknown, a series of tests were conducted on specimens as fabricated and on specimens that were exposed for 500 hr. in the Weatherometer.

The test panels were fabricated with the same equipment used in fabricating the shelter. Extreme care was taken to obtain a uniform panel thickness of about ¼ inch. A suitable spray grade resin and both types of roving mentioned before were used to fabricate the test panels. The finished panels consisted of approximately 70% resin and 30% roving by weight. The completed panels were cut in half, one half being placed in the Weatherometer while the remaining half was machined into mechanical test specimens.

The two Weatherometer samples were exposed for 500 hr. to a continuous carbon arc with an intermittent water spray. The samples showed little sign of degradation at the completion of the test. The samples were then machined into mechanical test specimens.

Table II, p. 117, summarizes the mechanical strengths.

Resin

It has been our experience that most commercially available polyesters are satisfactory or can be modified for use with mechanical resin depositors. However, certain criteria should be observed in order to obtain satisfactory operation. These include:

1. Viscosity should be reduced to about 500 cp. without the necessity of applying heat to the resin reservoir or fluid lines.

2. The resin should be 100% polymerizable and contain a minimum of volatile dilutants.

3. The catalyzed stability should be in the order of several days at room temperature.

4. The resin should cure with low exotherm.

5. A tack-free cure should be obtained at the air-resin interface.

6. No post cure at elevated temperatures should be required.

In recent months a number of resin formulators have marketed resins which conform generally to these criteria and are specifically designed for use with mechanical depositors.

Although we used a DeVilbiss pressure pot system for metering the resin sirups (Fig. 2, p. 117), a number of other metering systems are available to transport the components of the plastic system to the mixing heads of the depositor. Common to all is the division of the resin sirup into separate reservoirs; one containing the catalyzed portion, the other the activated portion. The amounts of catalyst and activator used to achieve a satisfactory gel time depends on the particular catalyst-activator combination chosen and the ambient condition at the time of operation. Generally, we had considerable success using 1% each of methyl ethyl ketone peroxide and cobalt napthenate, thus providing 0.5% of each component based on the total weight of resin. Average room temperature gel time is about 1 hr., which has proved satisfactory for "spray-ups" aggregating about 50 lb. total weight resin and reinforcement on a 2:1 ratio. When applied to large spray-ups such as the "spray-shell," this gel time allows for the spraying and compacting of a segment about 15 ft.^{2} in area which will retain sufficient tack to permit excellent bonding to adjacent sprayed segments.

It must be understood that the conditions described here are generalizations which cannot be rigidly applied since minor adjustments may be required to fit varying conditions. A certain control over gel time and compacting of the "as sprayed" fluff can be achieved by the agent used in the rolling or compacting operation.

Compacting method

Mohair rollers moistened with monomeric styrene were used to work entrapped air out of the

resin-glass mix after spray-up on wide relatively flat areas. For sharp corners and such, brushes or squeegees were more useful. Care should be taken in the compacting process because in an operation of this type, the glass is more easily moved or relocated by the rolling or brushing action than by the hand layup process. Monomeric styrene is used to dampen the rollers and other finishing tools in order to avoid pick-ups of the fluff during the compacting operation.

This could lead to uneven surfaces and varied laminate thicknesses. Since most spray-grade resins already contain styrene, the amount added to the laminate from the rollers does not affect the physical properties. It does aid the process by retarding gelation of the resin and provides more time to make a more compact, void-free laminate. It further aids in more thorough wetting of the glass fluff by providing an extruder for the resin. Rolling technique for obtaining the best laminate is usually developed through actual experience on various applications.

We have also used DAP, acetone, and unactivated resin as roller wetting agents with varying degrees of success. DAP tends to extend the cure time and, as would be expected, results in a prolonged tack at the air-resin interface. Acetone is not recommended and can be used only where the temperature is high enough (as in the hot sun) to cause rapid evaporation without excessive solvation of the resin. The use of unactivated resin tended to upset the resin-reinforcement balance and is more expensive.

Certain precautions should be observed in the operation of the mechanical depositor. The convergence of the fluid streams with the reinforcement stream on the output side of the depositor and the orientation of the depositor with respect to the mold profoundly affect the quality of the resultant spray-up. Ideally, the fluid resin streams from the spray heads should intersect the output stream of chopped roving just before the mixture impinges on the surface of the mold. Failure to observe this precaution can result in poor wet-out of the fiber and/or poor mixing of the fluid components. Also, if the depositor is held too close to the mold surface, the two streams of resin impinge without mixing; too great a separation results in excessive overspray. The best results are obtained by proper convergence of the output streams and normal impingement of the streams at the mold surface.

Several pitfalls were encountered in the course of erecting the "spray-shell." We found that there is no short cut to cleanliness. At the end of each day's operation, the spray heads should be completely dismantled and cleaned. Unless cleanliness of the spray gun is maintained, uneven output from the spray heads and lost man-hours will be experienced.

When working out of doors, it is nearly impossible to avoid the "blow back" or wind-blown particles of resin wet glass which tend to accumulate at the spray heads and around the roving cutter. The condition is aggravated by the rather large amounts of static electricity generated as the roving is pulled through the cutter. The accumulation is gradual and, unless attended to, will result in the slow unbalance of the fluid streams and in the roving sticking to and becoming snarled on the cutter drum. Each time the reservoir containing the catalyzed resin is refilled, the old resin must be cleaned out or it forms gelled strings and points of nucleation in the fresh mix that will plug valves and guns.

Although there are no specific Dept. of Defense directives specifying fire retardancy in structures of this nature, Air Force engineers chose to incorporate this requirement into specifications covering structures to be used in housing personnel and/or electronic gear;

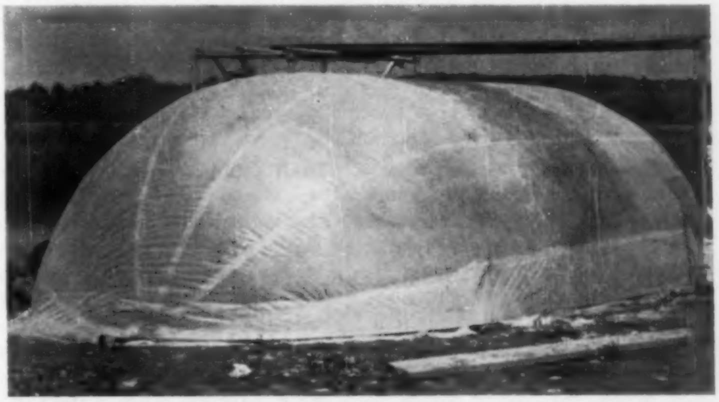

FIG. 4: Mold fully inflated. Scaffolding is used to facilitate spraying up at top of mold.

FIG. 5: Completed shelter prior to application of foam.

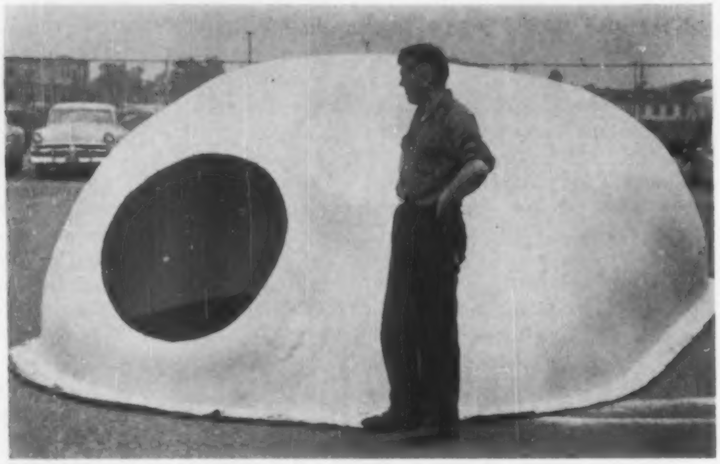

FIG. 6: Spray-shell with polyurethane foam layer and finish coat of Radolon paint. Access hole has been cut.

polyesters can be made flame-resistant in several ways: by chlorinating the resin by reaction, by adding antimony trioxide, and by adding a chlorinated wax. However, care must be taken that other desired properties, such as weathering, structural strengths, and spray-ability are not affected by the additives.

The spray-up operation

If proper precautions are taken, the mechanics of erecting a satisfactory shelter in the field are quite simple. An area large enough to erect the mold is cleared. The area need not necessarily be level but for simplicity of operation, we chose an open, level area. A shallow trench was dug across the line of the periphery of the mold to provide access to the interior of the mold when erected. A 55-gal. drum, open at one end and provided with a hinged closure at the other, was placed in the trench so that the flap faced the interior of the mold. The drum was covered with a layer of dirt to provide for sealing the bottom edge of the mold where it crossed the trench. Similarly, a trench was dug for the duct, which conducted the air from the blower to the interior of the mold (Fig. 3, p. 120).

A sectionalized tubular aluminum base ring conforming to the base contour of the mold was placed in position; the air supported mold, previously described, was located on the base ring and the hold down flap tucked under the base ring toward the interior of the mold. The blower motor was then started to provide some lift for the mold while the base flaps were being pulled into final position on the inside of the mold and pegged down.

L-shaped steel rods, about 18 in. long, were driven through the base flap into the ground adjacent to the metal hold-down ring so that the horizontal portion of the rod rested on the ring, thus anchoring it to the ground. An auxiliary strip of PVC was placed loosely between the inner wall of the mold and the ground to provide the final seal.

While the mold was inflating to the pressure capacity of the blower (about 1/4-in. water), the mechanical depositor was being readied for use.

The spray-up was started on the roof of the inflated mold (Fig. 4, p. 121) using the portable scaffolding. An area about 4 ft. sq. was sprayed, rolled, and resprayed until the compacted shell was about 3/16 in. thick (avg.). Spray-up and compacting were then shifted to an adjacent area and the process repeated until the mold was completely covered (Fig. 5, p. 121).

The glass roving used in the reinforcement contained a colored tracer strand so that the operator could judge the thickness of the deposited shell by the depth of color. With practice, this becomes a fairly effective control. There is no noticeable demarcation of delamination between consecutively sprayed areas nor is it necessary to feather out the edge of a sprayed area in order to achieve smooth surface transition between the areas.

The mold can be stripped from the shell almost immediately after the completion of the spray-up. Access holes, windows, partitions, or any other necessary modifications can then be made, using conventional hand tools. Total time to produce the structure was 80 man-hours.

The completed shell was sprayed with a single pass fo polyurethane foam, providing approximately 1 in. of insulation. As a final coating, Radolon,[2] an Air Force developed Hypalon white pigmented paint, was sprayed onto the polyurethane foam in order to provide additional weather resistance to the overall structure (Fig. 6, above.

This coating served primarily to reduce effects of solar radiation and served as a vapor barrier for the foam layer. Tests conducted in the laboratory on specimens of laminates and foam-in-place materials, both unpainted and painted with Radolon, showed no serious degradation in physical properties following the completion of 1000 hr. exposure to the standard Weatherometer cycling test.

The completed shelter weighed about 400 lb. and was easily moved about the area by five men.

Advantages

The spray-shell technique gives excellent promise that the reinforced plastics industry may undergo another industrial revolution by opening up vast new markets in the structural building field. Reinforced plastics can be applied almost anywhere in the field. A crew trained in the operation could set up the "kits," which would weigh only a few hundred pounds complete, erect the molds and spray-up shelters or housings in a matter of hours; then disassemble the kits and move on to other locations.

Some of the applications for the technique are farm shelters, temporary con- **(To page 198)**

[2]Available from B. F. Goodrich Co. (as A-625-B) and Goodyear Tire & Rubber Co. (as 1839-C).

Dr. Gordon M. Kline, Technical Editor

PLASTICS* TECHNICAL SECTION

MATERIALS • PROPERTIES • TESTING METHODS AND INSTRUMENTATION • STANDARDS • CHEMISTRY

Differential thermal analysis

. . . and its application to polymeric materials

By C. B. Murphy†

The applications of differential thermal analysis to the study of the chemistry and properties of plastics are reviewed. The DTA method is rapid and the thermograms provide significant information regarding the chemical and physical characteristics of the polymers. This paper describes the use of DTA for identification of polymers and for the determination of degree of cure, catalyst effects on cure, heats of polymerization, glass transition temperatures, and irradiation effects. As the number of polymeric systems studied by this technique is increased, other applications of the data may be expected to become evident.

Differential thermal analysis (DTA) is a technique developed by ceramists and mineralogists for studying the thermal phenomena, physical and chemical, occurring when materials are heated. The application of the differential thermocouple (Fig. 1, p. 126) gave the technique its name. In practice, one junction of the "backed" or differential thermocouple circuit is placed in a reference material and the other is embedded in the sample. The reference material is selected because it will undergo no thermal transformations over the temperature range to be studied. Generally, highly calcined alumina is used for this purpose. High melting organic materials such as isophthalic acid have been found very satisfactory for polymer studies. A separate thermocouple, usually embedded in more of the reference material, is used to record the ambient temperature and to determine the programming of the rate of heating imparted to the sample. More recently developed equipment utilizes the cell containing the inert material for insertion of this last thermocouple and, to obtain balanced thermal effects, incorporates a dummy thermocouple in the sample cell. All the thermal effects noted are a function of the sample, and are obtained as a plot of differential temperature versus time on an X-Y recorder. In programmed heating, time is related to temperature. Accordingly, the differential thermogram can be related to temperature.

A comparison of a differential thermal curve with a simple heating curve (Fig. 2, p. 126), will illustrate better what is taking place. Application of heat to a sample, illustrated in the lower (solid) curve, will cause an elevation of its temperature to the first point of transition. Further application of heat at this point causes an endothermic transition to occur with no temperature increase until the reaction is complete. At this point, the further application of heat will again increase sample temperature.

In the differential curve for the same material, the upper (solid) curve in Fig. 2, the initial application of heat will increase the temperature of both junctions of the differential thermocouple and, therefore, no emf is generated. The recorder pen would plot a straight line of zero slope. At the point where transition occurs, the thermocouple junction in the sample will remain at the same temperature during the transition, while the other junction continues to be heated. This differential in temperature generates an emf in the system, and a recorder pen deflection occurs. When the reaction is over, the junction in the sample will soon attain the temperature of the thermocouple embedded in the reference material, and a straight line of zero slope is again recorded.

This has been an idealized description of the process. Differences in the specific heats of the sample and the reference material will cause deviation from a straight line. This problem can be resolved in part by dilution of the material investigated with some of the inert material.

DTA apparatus

There is a wide variety of thermocouples from which to choose for DTA systems. Copper-constantan, iron-constantan, and chromel-alumel are some of the base metal combinations that have been used. Platinum-platinum rhodium is the most commonly used noble metal thermocouple. The selection must be made from the aspects of corrosion of the

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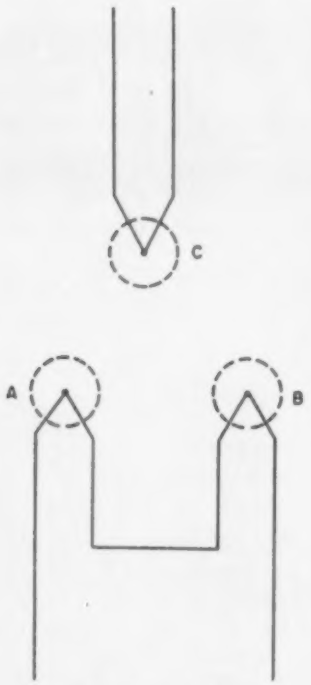

FIG. 1: Differential thermocouple circuit.

thermocouple by the materials studied and the thermal range to be studied.

Sample holders of a cylindrical type have been made from graphite, ceramic brick, alumina, aluminum, nickel, palladium, stainless steel, and other materials. Platinum foil has been wrapped about the sample to contain it and embedded thermocouples.

For the most part, furnace construction has consisted of a ceramic tube wound with a resistance wire element. The tube has been mounted vertically and horizontally; no particular advantage has been found in either method. Nichrome, Kanthal, and platinum wire have been most frequently used as heating elements. Globars have also been used. Recently, Hill and Murphy(11)[1] have devised a simple system utilizing an infra-red lamp as the heat source for low temperature work. This last system contains thermal gradients which can be confusing. A large uniform zone of heating, accommodating the sample block and thermocouples at the same temperature, offers greater potential success with the method. A typical differential thermal analysis apparatus is shown in Fig. 3, p. 127. After a basic equipment design has been established, there are several factors that influence the thermograms obtained with it.

Particle size: It has been pointed out by Norton(22) that the particle size of the sample has a distinct effect on the thermogram. Norton said that the smaller particles give off their heat more readily. It has also been shown(8) that the temperature at which reactions begin and end will be lowered with increased fineness of the sample. Results published by Berg(2) showed an increased peak area as well as intensity with increased fineness of the sample. The bulk of this work has been conducted with clays. These are such complex chemical structures that there is no assurance that various fractions have the same composition. Further efforts in this direction should be made with materials of unquestioned structure and purity.

Heating rate: Rates of heating from 0.5 to 100° C. per minute have been employed. Because a rate of heating is employed, the temperatures recorded are not those of equilibrium conditions. A time lag occurs. The slower the rate of heating is, the smaller the time lag. However, with a slow rate of heating, the temperature differential between the reference material and the sample will become less, tending to reduce some peaks to insignificance. With a rapid rate of heating, peaks become intense and considerable detail is lost. Standardization recommendations made at a geological congress(13) called for a heating rate for the sample of 10° C. per minute, with a maximum variation of 1° C. per minute.

Atmosphere control: Addition to DTA equipment of means to control the atmosphere surrounding the sample is very desirable. It permits the separation of purely thermal effects from oxidative phenomena, the former occurring in an inert media, whereas the latter appear in an oxygen or air atmosphere. A commercially available apparatus[2] permits operation from vacuum to 6 atmospheres pressure, with a single gas or a mixture of gases passing through the sample. An attachment permits water vapor to be included as one of the gases. Endothermic reactions resulting from phase transitions with the sample under vacuum would show little or no tendency to shift under pressure because of the lack of pressure dependency of such reactions. However, endothermic reactions originating from the volatilization of decomposition products, i.e., CO_2, water, hydrogen halides, etc., would exhibit peaks at lower temperatures under vacuum.

Auxiliary apparatus

As has been pointed out, DTA consists of the registration of the thermal effects occurring in a material on heating. It is obvious that difficulties can be encountered in assigning significant phenomena to the peaks registered on the thermogram. Methods of obtaining auxiliary data to assist in the interpretation are available.

Thermogravimetric analysis (TGA), a method of studying weight loss with temperature, usually programmed at 2.5 or 5.0° C. per minute, can differentiate between physical and chemical changes. No weight loss would be indicated during a physical change, but most chemical changes occurring in polymeric materials would be accompanied by a weight change. Doyle(9) has found very good agreement between DTA and TGA decomposi-

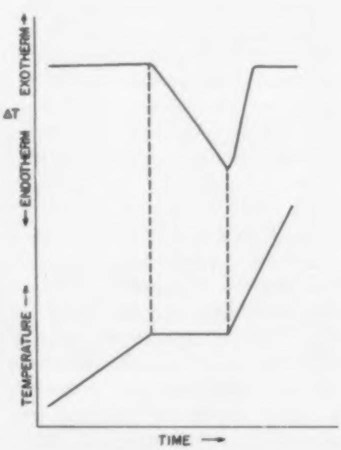

FIG. 2: Comparison of a differential thermal curve with simple heating curve.

[1] Numbers in parentheses denote references at the end of the article, p. 199.

[2] Dynamic Gas Differential Thermal Analysis Apparatus, distributed by Robert L. Stone Co., 2607 Hillview Rd., Austin 3, Texas.

tion temperatures with polymethyl methacrylate, polychlorotrifluoroethylene, and several other polymeric materials. Although it has not found widespread application, Powell(24) has developed equipment giving simultaneous TGA and DTA curves from one sample.

Recently, a system has been devised(19) to permit sampling of gases evolved during the registration of peaks on a DTA thermogram. The method was applied to the 300°C. endotherm occurring in polyvinyl chloride and the gas evolved was determined to be hydrogen chloride. This innovation permits definite assignment of phenomena to the peaks, and can permit establishment of degradation mechanisms.

Sample preparation

In the study of polymeric systems, there is interest in both solid and liquid samples. Finely powdered samples are required for DTA of solids in order to increase the compaction of the sample about the thermocouple and thus increase the sensitivity of the measurement. However, care must be taken in the preparation of powdered samples so that the thermal energy encountered in grinding does not affect the state of the material. In order to avoid this, the plastics were cooled with dry ice, broken into fragments by impact, and passed with dry ice through a grinder, which had previously been cooled with dry ice. This procedure was used with the grinder at its coarsest setting, and repeated at the finest setting.

In the case of liquid samples, both cells of the equipment are filled with inert material, usually Al_2O_3, and a drop of the liquid is added to the specimen cell. This use of an inert diluent is useful in differential thermal analysis in that it renders the specific heat of both the reference material and the specimen mixture more nearly equal. In the selection of the inert material for this type of application, one must be aware that catalytic effects can occur.

Qualitative analysis

A number of investigators have shown the applicability of this technique to the identification of polymeric materials. Morita and Rice (16) have applied the method to polyvinyl chloride and copolymers of vinyl chloride and vinyl acetate, and have shown identifiable differences in these systems. Subsequent investigations by Morita have demonstrated the usefulness of the method in differentiation between polyglycosans(14) and starch and polysaccharides (15). Perkins and Mitchell(23) have also applied the method to starches and proteins. Doyle (10) has given the thermograms for a large number of polymers, and, in addition, has indicated advantages and difficulties of specific types of equipment for this kind of work. Anderson and Freeman(1) have applied DTA to a large number of saturated polyesters, and have found that there were distinct categories into which each of these materials could be divided.

The method offers the potential of being able to characterize materials much like infra-red spectra. However, the application is in its infancy. It should also be pointed out that because of instrumental variations from one piece of equipment to another, the thermograms will agree only in over-all characteristics. To be of maximum value, a library of thermograms should be generated on the same equipment.

Degree of cure

If one associates continued reaction with degree of cure, i.e., the thermal polymerization of unsaturated bonds, rupture of epoxy rings, etc., such reactions would generally generate heat while undergoing further polymerization. Such thermal effects can be detected by DTA.

Clampitt, German, and Galli (5) have applied DTA to the polymerization of triallyl cyanurate and observed that two exothermic peaks were produced on the thermogram. The lower temperature peak, resulting from the first stages of polymerization, was associated with the polymerization of the first two allyl groups of the triallyl cyanurate. The high temperature exotherm was associated with polymerization of the last allyl group. These investigators also observed the same effect in the Vibrin[3] 135 system.

Murphy et al.(20) applied DTA to three samples of Vibrin 135 resin prepared, using *tert*-butyl perbenzoate as catalyst, in a manner that would lead to differences in degree of cure. The first sample was prepared in a gelled condition at room temperature, and was given no further treatment. The second sample was cured at 80° C. for 24 hours. The third sample, treated like the second, was given an additional post-bake at 180° C. for 24 hours. These materials, designated as 1, 2 and 3, respectively, gave the thermograms shown in Fig. 4, p. 128.

Two distinct exothermic processes are also observed in these thermograms. The first, a low temperature exotherm peaking at 150 and 180° C., appears in curves 1 and 2, respectively. This low tem-

[3] Trademark of Naugatuck Chemical, Div. of United States Rubber Co.

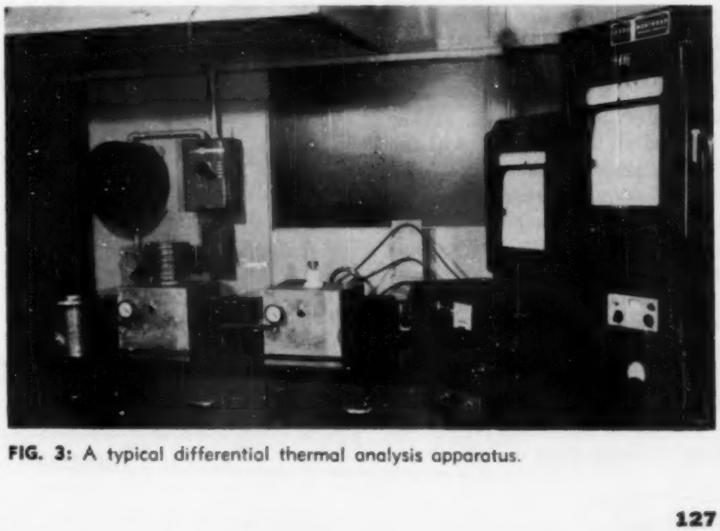
FIG. 3: A typical differential thermal analysis apparatus.

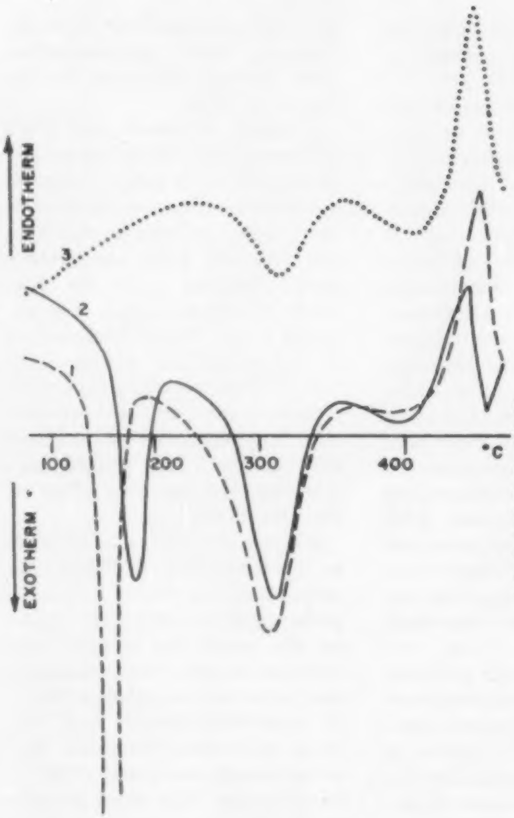

FIG. 4: Differential thermal analysis of Vibrin 135 resins. Curve 1: resin gelled at room temperature; Curve 2: resin cured at 80° C. for 24 hr.; Curve 3: same resin as 2, post-baked at 180° C. for 24 hours.

perature peak is completely missing from the post-baked material. The second exothermic reaction, with a peak at approximately 320° C., is found in all three curves, diminishing in intensity from 1 through 3. This order, also observed with the low temperature exotherm, is the reverse order to the degree of cure.

Vibrin 135 resin is essentially a mixture of glycol maleate polyester and triallyl cyanurate polymer. Previous application of the differential thermal analysis technique to cured and undercured polyester resins(17) showed low temperature exotherms (125 to 175° C.) associated with their thermally induced cure. These data led to the assignment of the low temperature exotherm to the thermal polymerization of residual unsaturation in the polyester and the second allyl group of triallyl cyanurate. The high exotherm must be attributed to the third allyl group of the triallyl cyanurate, which had not completely reacted in any of the three samples that were used.

The most significant aspect of these investigations was the demonstration that cure in a resin system is not a simple process. In both systems two distinctly different reactions, each exhibiting its own exotherm, were observed. Although many investigators are endeavoring to relate physical properties of polymeric systems to degree of cure, this dual nature of cure would seem to complicate such relationships.

Murphy and co-workers(21), continuing the work in the Vibrin 135 series, prepared two resin samples in an identical fashion with the exception of the catalyst employed. Sample A was prepared using 2% *tert*-butyl perbenzoate (TBP) as a catalyst; Sample B was prepared with 1% benzoyl peroxide (ATC). Both samples were cured at 80° C. for 24 hours. The thermograms from finely ground specimens of these materials are given in Fig. 5, below.

Curve A shows a low temperature exotherm at 180° C., not present in Curve B. Both curves exhibit high temperature exotherms at 300 and 310° C. From previous assignment of peaks in the Vibrin 135 system, it is obvious that benzoyl peroxide effects the greatest degree of cure, eliminating all traces of the peak associated with the cure of the polyester portion of the system and the second allyl group of the triallyl cyanurate. Both curves exhibit essentially the same degree of cure associated with the third allyl group of the triallyl cyanurate portion of the resin system.

It is interesting to note that the difference between Samples A and B is one of kind rather than degree. Other methods of detection of residual polymerizable material do not afford such a clear cut differentiation as exhibited by the DTA method. For example, it is well known that the electrical loss and mechanical damping of a cross-linked polymer are decreased by increased polymerization, whereas the glass transition temperature is increased. The changes in such

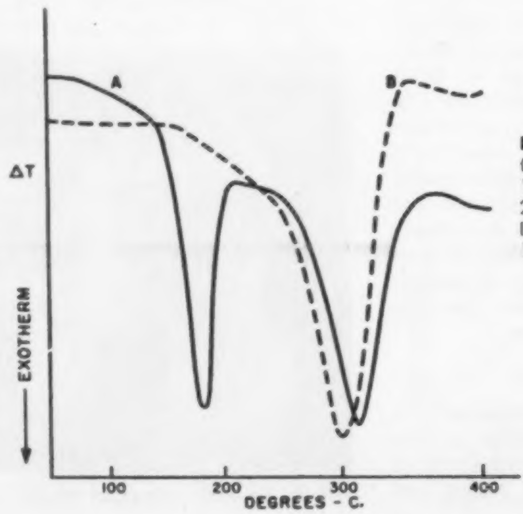

FIG. 5: Catalyst effect on cure of Vibrin 135 resins. Curve A: 2% tert-butyl perbenzoate; Curve B: 1% benzoyl peroxide.

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Table I: Heats of polymerization from DTA measurements

Material	Heat liberated during exotherm — First	Second
	cal./g.	cal./g.
Triallyl cyanurate	156	420
Vibrin 135 alkyd	23.0	—
Vibrin 135	131	137
Diethyl fumarate, triallyl isocyanurate	80.0	—

Table II: Glass transition temperatures determined from DTA measurements

Polymer	Source	Transition temp.
		°C.
Polyvinyl chloride	Marvinol VR-10	80.5
	Exptl. lab. sample	74
Polymethyl methacrylate	Exptl. lab. sample	111
Polystyrene	Dow 666K	83
Copolymer of vinylidene chloride and vinyl chloride	Saran wrap (Dow)	−5

properties, however, are small in comparison with the error associated with their measurement. Other physical properties, such as hardness and stiffness, do not change monotonically with increasing cure. Appropriate physical tests remain indispensable to the effective application of polymers, but it would appear that curing schedules are best determined on the basis of DTA.

Heat of polymerization

The relationship of a peak area in a thermogram to the heat of reaction has been discussed by Borchardt and Daniels(3), and many others. The application of differential thermal analysis as a microcalorimeter has been demonstrated by Sabatier(25) and Wittels(27). Stone(26), using the dynamic gas method of differential thermal analysis, followed the decomposition temperature of magnesite with increasing carbon dioxide pressure. When log p is plotted against $1/T$ (the Clausius-Clapeyron equation), the slope of the plot, $-\Delta H/R$, was used to determine the heat of dissociation. These investigations point to the possibilities that exist.

Heats of polymerization have been determined by Clampitt, German and Galli. Their investigations have included triallyl cyanurate and triallyl isocyanurate(5), and triallyl cyanurate-polyester resins(6). Their data are presented in Table I, above.

Glass transition temperatures

Although Coste(7) mentioned the possibility of measuring glass transition temperatures by the DTA method and Chackraburtty (4) has shown an inflection at 28° C. (the reported glass transition) in the thermogram of polyvinyl acetate, it remained for Keavney and Eberlin(12) to demonstrate the practicability of this approach.

Table III: Glass transition temperatures of polyacrylonitrile as a function of molecular weight, from DTA measurements

Molecular weight	Transition temp.
	°C.
1500 to 2000	56 ±1
2600 ±300	None detected
8500 ±15%	73 ±2
60,000 ±15%	74 ±3
200,000	80.4 ±2
>300,000	79 ±1

(Table II, below). Although reasonable agreement exists with values reported in the literature for these materials, it is evident that temperature ranges may be expected as shown by the two results obtained for PVC.

Keavney and Eberlin(12) determined the glass transition temperature of polyacrylonitrile as a function of molecular weight. As might be expected, their results show dependency on molecular weight. (Table III, below).

This method has been found to give values comparable to other techniques employed to measure polymer glass transition temperatures, and it has the convenience of being very rapid. Heating rates between 1 and 6° C. per minute employed with polymethyl methacrylate and polystyrene samples demonstrated that the measurement of the glass transition temperature was independent of heating rate in this range.

Irradiation effects

It would be anticipated that linear polymers would show a melting point, a phase transition, or a chemical reaction that could be expected to change on irradiation. Murphy and Hill(18) have shown that DTA is capable of detecting changes in polymeric systems as a result of gamma radiation from a cobalt-60 source.

Polyvinyl chloride, for example, shows a decrease in the endotherm associated with liberation of hydrogen chloride after irradiation. Polytetrafluoroethylene, irradiated and non-irradiated, shows an endothermic peak at 340° C. resulting from a phase transition; this peak increases in the irradiated material. Gamma radiation converted Versalube F-50 from an oily liquid to a resinous mass; irradiated and non-irradiated specimens exhibited exothermic decomposition starting at approximately 360° C. This peak is associated with a high fraction of dimethyl siloxane, which undergoes a siloxane rearrangement at 310 to 320° C. This flattened peak of the irradiated material shows decreased siloxane rearrangement because of greater rigidity of the radiation-induced crosslinking.

The DTA technique permits studying effects in- **(To page 199)**

An all-hydrocarbon thermosetting resin for electrical insulation

By Hadden Clark* and R. G. Adams*

A new all-hydrocarbon thermosetting resin, called Buton[1] A-500, possesses considerable potential in the electrical field. Its attractive features include high resistance, low loss factor and dielectric constant, very low water absorption, high dielectric strength, and good arc resistance. The electrical properties have been found to be quite stable to changes in temperature and current frequency. The resin forms a strong bond to polyolefins, and combinations can be used to achieve specific combinations of electrical and physical properties.

Various forms of the material have been developed for specific end uses. The resin has been processed as castings, single-stage-cured reinforced panels, B-stage cures, and laminating varnish solutions for impregnating paper and glass reinforcements. The many possible forms and combinations suggest its use in a variety of electrical products produced by conventional processing and fabrication techniques.

An all-hydrocarbon resin, in pilot plant production and available in semi-commercial quantities, is in the developmental stage in several application areas of thermosetting plastics. The material is a copolymer of butadiene and styrene, containing side vinyl groups attached to the polymer backbone. These groups are reactive sites for subsequent crosslinking with vinyl monomers to form a thermoset.

Initial applications development work on the resin has mainly been in product areas where the all-hydrocarbon character would be an advantage. One such outstanding area is in electrical insulation. This article presents data on the electrical and other properties of this resin, designated as Buton A-500 (formerly C-oil).

Properties of Buton A-500

The resin is available as approximately 100% reactive material. It is transparent and almost water-white, and at room temperature is a heavy sirup of about 4000 to 4700 poises viscosity. The general physical properties are:

Active ingredient	99 to 100%
Specific gravity	0.915
Viscosity[2], poise	1.2 to 1.5
Refractive index	1.53
Color[2], Gardner	1
Acid number	0
Oxygen content	0

The resin has excellent storage stability in closed containers, and has been used after one to two years. However, there has been some skinning of the surface noticed in open or partially filled containers. The problem can be avoided by diluting the resin with monomer when the can is opened, as these mixtures do not skin over in contact with air. Solutions containing styrene or vinyltoluene have been prepared in ratios of 80 resin/20 monomer to 50 resin/50 monomer. An antioxidant, such as 200 p.p.m. 2,6-di-tert-butyl-p-cresol, can be added to give these solutions excellent stability when stored in glass bottles or tin cans.

Table I: Properties of cured Buton A-500 resin[a]

Appearance	Transparent
Refractive index	1.563
Density	1.01 to 1.03
Flexural strength, p.s.i.	8,500 to 14,000
Flexural modulus, p.s.i.	3.3 to 3.7 × 10^5
Heat distortion temperature, °F.	186 to 280
Water absorption, 24-hr. immersion at 72° F., %	0.0 to 0.05
Volume resistivity, ohm-cm.	[b]>6.56 × 10^{16}
Dielectric constant	
10^3 cycles	2.53
10^6 cycles	2.53
8375 megacycles[c]	2.46
Dissipation factor	
10^3 cycles	0.0011
10^6 cycles	0.0014
8375 megacycles[c]	0.007
Arc resistance, sec.	78
Dielectric strength, short time, ⅛ in. specimen, v./mil	808
Surface resistivity	
50% R.H., ohms	31.0 × 10^{12}
96% R.H., ohms	24.5 × 10^{12}

[a] A.S.T.M. test methods were used. [b] Limit of measuring instrument. [c] Radar frequency.

Resin cures

Buton A-500 can be heat converted to a hard insoluble resin. Noncatalytic cures have been effected at 400 to 500° F. for extended periods of time. Curing has been carried out in vacuum ovens to prevent oxygen reacting at these high temperatures. The electrical properties of these materials have been excellent.

Most applications require faster cures and for this purpose 30 to 50% of a crosslinking monomer is included in the blend. Monomers vary considerably in their reactivity with the resin. For instance, styrene and vinyltoluene readily crosslink with the resin, whereas α-methylstyrene will not coreact. Of these monomers, vinyltoluene has been preferred because of its higher boiling point. This is particularly important for

*Esso Research & Engineering Co.
[1] Trademark, Esso Research & Engineering Co.
[2] 50% solution in Varsol.

cures where temperatures of 290 to 350° F. are used. Otherwise, the properties of resin/styrene formulations are equivalent to resin/vinyltoluene compositions.

Change in resin/monomer ratio can be used to control viscosity, for example:

Composition	Viscosity, poise 77° F.	Viscosity, poise 210° F.
100 resin	4600	13.0
60 resin; 40 vinyl-toluene	3.62	0.42
50 resin; 50 vinyl-toluene	1.23	0.21

A change in resin/monomer ratio also alters the cure rate. Mixes high in monomer have the faster cure rate; however, there is an increase in cure exotherm and volatility. Two ways to avoid the problem of volatility are to use a B-stage cure technique, with the B-stage formed at a low temperature, or to use the resin in the form of a laminating varnish to make a preimpregnated material. Both of these techniques are described in the section on processing, p. 138.

Studies have shown that the properties of laminates made with 70/30, 60/40, and 50/50 resin-to-monomer ratios are approximately equivalent as long as a full cure has been reached.

Other reactive monomers have also been co-cured with the resin. However, for optimum electrical properties an all-hydrocarbon system has been preferred. For particular applications where these are not paramount, monomers such as diallyl phthalate and diethyl fumarate have been used.

Catalysts

Peroxide catalysts are generally used to cure Buton A-500 formulations. Of the various types, the dialkyl or dialkyl aryl peroxides are most effective. Both dicumyl peroxide (Dicup) and di-tert-butyl peroxide (DTBP) give good hard cures. In a comparison of the two, Dicup will give slightly higher flexural strengths at room temperature, whereas DTBP promotes retention of strength properties at elevated temperatures.

Peresters have been used to cure the resin and both tert-butyl perbenzoate and tert-butyl peracetate will cure resin/monomer blends. However, strength properties and hardness values have been somewhat lower than with the dialkyl peroxides. In contrast, the hydroperoxides and benzoyl peroxide (BPO) do not give hard cures with Buton A-500 formulations. Although benzoyl peroxide is not effective in giving a full cure, it has been used to promote the formation of a B-stage, or to act as a "kicker" to give a faster cure in combination with the dialkyl peroxides. Concentrations of 0.25 to 0.50 parts per 100 resin or blend (p.p.h.) have been used. A further discussion of this technique is given under the section on processing.

The resin requires a relatively high amount of catalyst. When cure rate is of prime importance, a combination of 0.25 BPO, 2 Dicup, and 2 DTBP has been used at temperatures from 325 to 360° F. When longer press cure times or postcures can be tolerated, 3 Dicup or 2 Dicup and 1 DTBP have been used as catalysts. As long as a full cure is obtained, these three catalyst compositions give laminates with about the same flexural strength properties at room temperature.

The time necessary to reach full room-temperature strength varies inversely with the cure temperature. Cures have ranged from 40 min. at 300° F. plus a 2-hr. postcure at 350° F., to 30 min. at 325° F., to 2½ min. at 380° F. The recommended conditions are very dependent on the press to be used and the type of product being manufactured.

Reinforcing agents and fillers

Although inorganic and organic fibers have been used to reinforce the resin, most of the work has been with glass. Standard test laminates ⅛ in. in thickness have been produced using 181-weave glass cloth.

The results obtained have been very dependent on the finish used with the glass. Buton A-500, being an all-hydrocarbon system, does not have good adhesion to glass if there is no coupling agent present. Laminates made with No. 112 glass cloth (heat cleaned) have been opaque and have had poor strengths, both dry and wet. However, the conventional vinyl silane coupling agents are very effective in promoting a good bond, and laminates made with No. 136 or A-172 finish (Linde Div., Union Carbide Corp.) pretreatment on the glass have good strengths and excellent resistance to water.

It has recently been found that heat-cleaned glass can be used if the vinyl silane (A-172) is put directly into the resin formulation. The silane has been used in concentrations of 0.25 to 1.00 p.p.h. with 0.50 to 0.75 p.p.h. giving the best results. Fillers used have included the calcium carbonates, clays, organic materials, and the like. Some fillers have been found to inhibit (To page 138)

Table II: Properties of glass cloth laminates[a]

Glass content, wt. %	72
Flexural strength	
Dry strength, p.s.i.	60,000 to 65,000
Retention after 2-hr. water boil, %	90 to 100
Retention after 7-day water boil, %	85
Retention after 1 wk. at 500° F., %	70
Flexural modulus, p.s.i.	2.7×10^6
Tensile strength, p.s.i.	54,000
Compressive strength, p.s.i.	46,200
Izod impact strength, ft.-lb./in. of notch	23
Water absorption, 24 hr. immersion at 72° F., %	0.03
Volume resistivity, ohm-cm.	3×10^{15}
Insulation resistance after 28 days at 90% R.H. and 95° F., ohms	$>2 \times 10^{12}$
Dielectric constant	3.62
Dissipation factor at 10^6 cycles	0.001

[a] A.S.T.M. test methods were used to test ⅛-in.-thick laminates made with 14 plies of 181 glass cloth having 136 finish.

HERCULES

Plastics Hi-Lites

Vol. II, No. 3

New Housing Projects, 1960 Style

Product builders achieve significant improvements with Pro-fax® polypropylene

BULLETIN

WASHINGTON, D. C. . . . The Food & Drug Administration has issued a formal regulation, appearing in the Federal Register, authorizing the use of Pro-fax polypropylene in products coming in direct contact with all kinds of food. Pro-fax thus becomes the first packaging material to win approval through the issuance of a formal Food Additives regulation. Author of the successful petition was Hercules Powder Company. Hercules predicts widespread use of Pro-fax in food uses, including packaging films, molded containers, coatings, liners and dispensers used in food handling.

Plastic housings in all manner of sizes and shapes, used in an across-the-board list of products, are among the first big developments of the '60s . . . an exciting clue to things ahead. Materials such as Pro-fax polypropylene are fast changing the face and function of many a product, lending new color and styling appeal, improved performance, and above all—*lower cost!*

Measured by yesterday's standards the achievements of today's new materials border on the impossible: they provide high resistance to heat, moisture, household chemicals, foods and cosmetics. They offer rich color and are ideally adapted to the attractive styling requisite for modern merchandising. Yet because they are low-cost materials, adaptable to rapid cycle injection-molding, they are *priced right!*

No wonder that just about every new plastic housing project you see these days is a Pro-fax project. Here are a few of the latest.

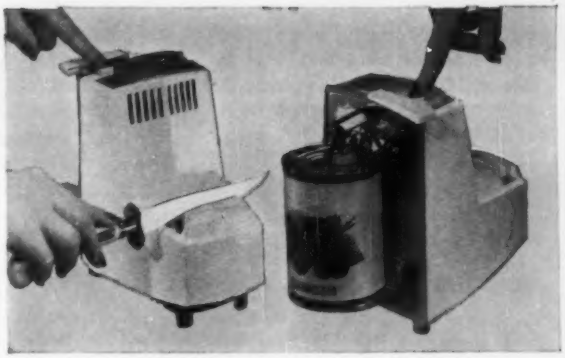
AROUND THE YARD

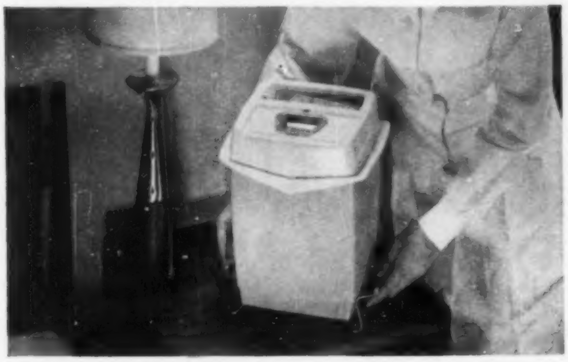
A handsome Pro-fax housing is the new symbol of quality on today's modern power mower. An excellent example is this high-styled motor shroud for the 1960 Power-Matic. Its beauty belies its rugged strength, for this sturdy housing is virtually unbreakable and will permanently resist heat, moisture, gasoline, oils and greases. Molded-in mountings eliminate the need for metal parts in the assembly, providing a design that is completely corrosion-proof. In addition to the Power-Matic shroud, Amos Molded Plastics, Edinburg, Indiana, has designed, developed and produced a series of similarly well-engineered Pro-fax mower housings for Power Equipment, Cicero, Indiana, and its value-conscious customers.

IN THE KITCHEN

Pro-fax in the kitchen spells new convenience and satisfaction for homemakers. Knapp-Monarch's Redi-Matic automatic can opener-knife sharpener features a gleaming white Pro-fax housing, and as a result is impervious to damage from staining and rough handling. The Redi-Matic automatically opens cans of all shapes, and sharpens knives of all sizes. Thanks to Pro-fax, it's a luxury styled unit designed to blend beautifully with any kitchen decor.

Molded by: Warren Molded Plastics, Cortland, Ohio.





ABOUT THE HOUSE

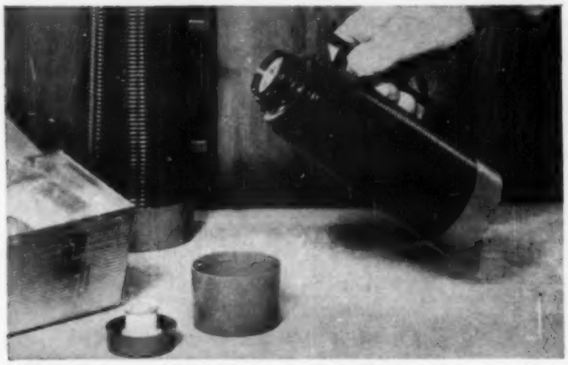
Fast becoming standard home accessories, vaporizers and humidifiers have gotten a big boost in appearance and function by the use of Pro-fax. The new Northern automatic vaporizer/humidifier (shown here) features a bowl and lid molded with Pro-fax, in contrasting colors, which combine in a compact, easy-to-carry appliance that is both useful and attractive wherever it serves in the house.

Pro-fax bowl and lid molded by Cruver Manufacturing Company, Chicago, Illinois.

IN THE NURSERY

Modern style and top performance go hand in hand in Formulette's bottle warmer. It's molded with Pro-fax, of course, for a luxury finish plus resistance to heat and moisture, in a rigid, thin-walled, lightweight unit that is easy to handle, always safe and the ultimate in completely sanitary nursery equipment.

Molded by Boonton Molding Company, Boonton, New Jersey, for Formulette Company, Inc., Jamaica, New York.



IN THE LUNCH BOX

Breadwinners, too, enjoy the convenience and luxury of Pro-fax. The handle, jacket, and collar of Aladdin's new Dura-Clad vacuum bottle, with its unique "Pitcher-Pour" handle, are all molded in one piece with Pro-fax. Pint-size (shown here in use) fits all workmen's lunch kits while the quart size (appearing in the background) is designed to fit conventional outing kits. Both models are heat-, scratch-, and stain-proof.

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HERCULES

Buton A-500 cures, while others have little or no effect. For instance, Minerals & Chemicals Co. ASP-400 (an untreated clay) severely inhibits the cure, whereas ASP-103 and ASP-403 have no effect. As a general rule, fillers that have a pH close to neutral should not have any effect.

Resin and laminate properties

Properties of both resin castings and laminates have been determined on test samples prepared in the following manner.

A mold consisting of two aluminum plates ¼ in. in thickness was used with a ⅛ or 1/16 in. iron spacer to control the thickness of the sample. In making the test panel, the separator was first placed on the bottom aluminum plate. Strips of electricians' unvulcanized rubber tape were placed on the separator frame to act as a gasket seal. Mylar[3] film was placed on top of the gasket.

For a resin casting, the formulation was poured into the cavity, a sheet of Mylar film and the top aluminum plate positioned, and the assembly placed in a heated platen press. Pressures of 15 to 150 p.s.i. were used, depending on the individual experiment. During the press close, the uncured rubber gasket formed a continuous seal around the cavity. The cure was carried out at the desired time and temperature, and the panel removed from the mold and hung vertically to cool. The panel was tested "as is" or postcured where desired.

For laminates, 10 to 14 plies (depending on the desired glass content) of 181 glass fiber cloth were impregnated and laid up on the Mylar film on the bottom of the mold. A sheet of Mylar was used as a top cover and the air bubbles worked out of the panel with a spatula. The second aluminum plate was placed on top of the mold, and the assembly placed in a heated platen press for the desired cure time and temperature at 15 to 150 p.s.i.

[3] Trademark, E. I. du Pont de Nemours & Co. Inc.

Tests on both the resin castings and the laminates were carried out according to ASTM procedures. The properties of typical cured panels are given in Table I, p. 132. The cured resin is transparent and almost water-white, with the low density of 1.01 to 1.03. The range in flexural strengths in the table was obtained with three different catalyst combinations of Dicup and DTBP (4 Dicup/1.5 DTBP, 2 Dicup/2 DTBP, and 3 DTBP). The highest strengths were obtained with the 2 Dicup/2 DTBP catalyst, and ranged in individual samples from 11,000 to 14,000 p.s.i.

The resin, being all-hydrocarbon, has very low water absorption and also has excellent resistance to both acids and bases. Of more significance, the electrical properties of the resin are also outstanding, with a dielectric constant and dissipation factor that are stable over a wide frequency range. Because of the extremely low water absorption, these properties are also stable over a wide humidity range. Electrical tests have also been carried out at room temperature and 275° F. There was very little change in dielectric constant, dissipation factor, or volume resistivity at the two temperatures.

The general physical and electrical properties of glass cloth laminates are given in Tables II and III, p. 134, and below. Tests were made on laminates with three levels of glass content. The physical properties show good strength and especially retention of strength after a 2-hr. or 1-wk. water boil. These tests are indicative of the wet strength obtainable with a suitable coupling agent (136 or A-172 vinyl silane finish).

The electrical resistance is also quite stable both to humidity and (Table III) changes in frequency. The dielectric properties of these laminates are proportional to the volume ratio of the glass and resin and vary with glass content.

Processing

One-stage cures: The test panels discussed so far have been made in single-stage cures in closed molds. Positive pressure is required to ensure a void-free laminate when curing at temperatures of 300 to 350° F. This pressure may be quite low, and 15 p.s.i. to contact pressure has been used in this temperature range.

B-stage cures: Buton A-500 forms a very stable B-stage which is moldable. The B-stage has been prepared in a variety of forms including resin, filled resin, and molding compounds. A typical B-stage formulation would contain 60 parts resin/40 vinyltoluene/2 divinylbenzene (55%)/0.25 benzoyl peroxide/2 Dicup/2 di-tert-butyl peroxide. The B-stage is reached fairly rapidly at 240 to 260° F., requiring from 2 to 6 minutes. When cooled, the material can be handled as a solid. Contact pressure only (or no pressure at all) is required.

Final cures have been carried out in 40 min. at 325° F. to 2½ min. at 380° F. Strengths obtained in test panels have been almost the same over this cure temperature range with the lower temperature cure giving somewhat higher values. The catalyst composition of the formulations can be tailored.

Laminating varnish: A resin varnish has been developed containing 50 to 75% solids in the solution. This material has been used in the typical preimpregnated paper or cloth operations. The material can be applied in the conventional drying towers used in the laminating industry. The resin in the solution is nonvolatile, and on drying will form a tack-free or (To page 201)

Table III: Electrical properties of Buton A-500 glass cloth laminates

Property	Glass content of ⅛-in. thick 181-cloth laminate: 12 plies	10 plies
Dielectric constant		
10^3 cycles	3.62	3.52
10^6 cycles	3.62	3.52
6×10^7 cycles	3.62	3.52
Dissipation factor		
10^3 cycles	0.002	0.002
10^6 cycles	0.001	0.001
6×10^7 cycles	0.002	0.002
Insulation resistance, ohms	$>10^{13}$	$>10^{13}$

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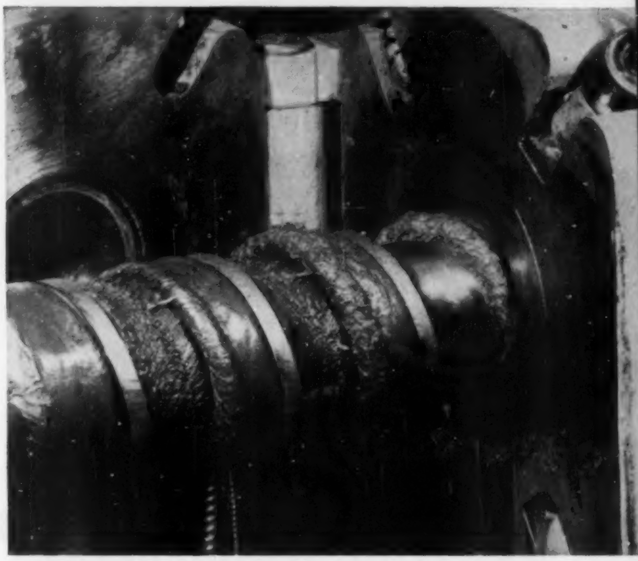
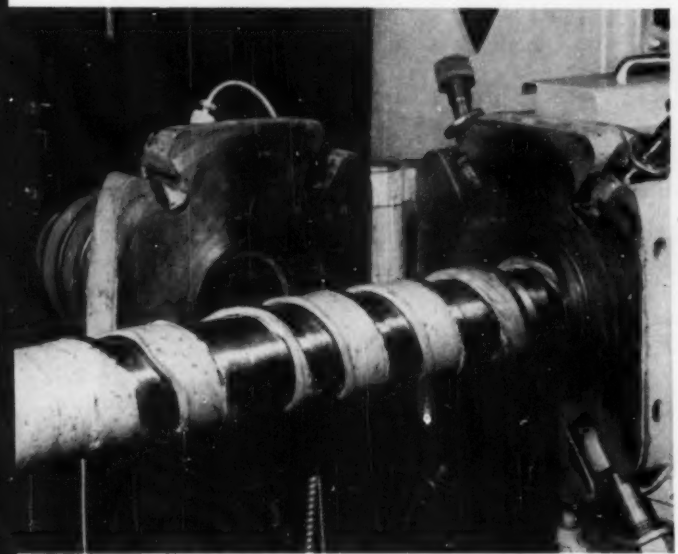
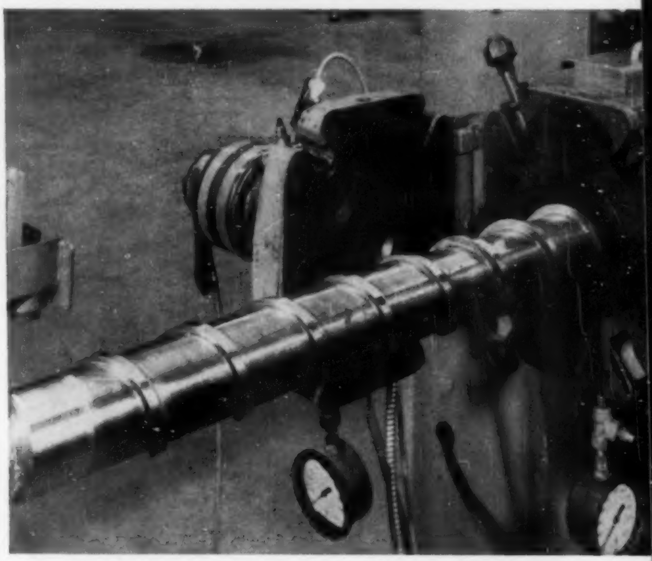


2. Operate machine to purge old material.



3. Note how A-C Cleaning Compound strips off easily.



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One extruder tells us that he saves $5,000 by using A-C® Cleaning Compound—cleans a machine in 1½ hours without tearing it down.

You'll find A-C Cleaning Compound speeds changing material or colors, and eliminates cylinder contamination. It purges without scratching and strips cleanly and easily from extrusion screws without mess.

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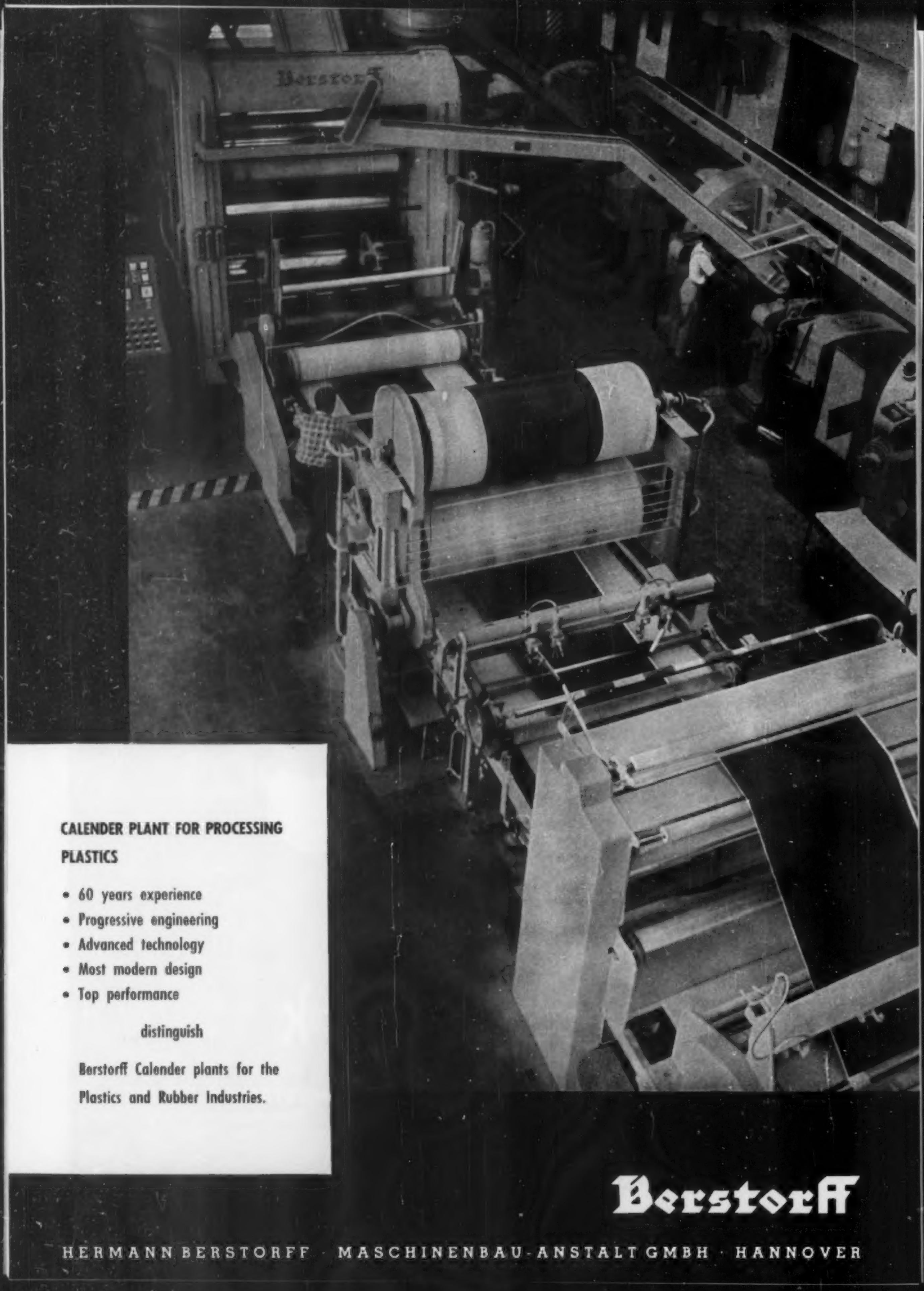
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Previewing macroPlastic

INTERNATIONAL EXPOSITION

Utrecht, Holland, October 19-26, 1960

AND CONGRESS, Amsterdam, October 17-19, 1960

On October 17, 18, and 19, at the Koninklijk Institut voor de Tropen, Mauritskade 63, Amsterdam, The Netherlands, the 1960 International Congress on the Technology of Plastics Processing will be held. And from October 19 to 26 in the Croeselaanterrein Park in Utrecht, the second international plastics exhibition "macroPlastic" will be held.

Why should a plastics show and conference in Holland be important at this time, particularly to those of us in America?

1. The Netherlands is the core of the European Common Market, which is the outgrowth of Benelux and includes also Belgium, Luxemburg, West Germany, France, and Italy. Surrounding the E.C.M. is the Circle Market, which includes Great Britain, Norway, Denmark, Sweden, Switzerland, Austria, and Portugal. Both these trade organizations are dedicated to the reduction of tariff barriers and freedom of payment between their members.

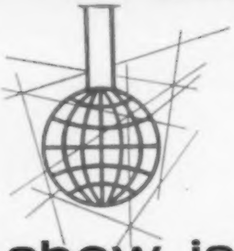
2. The desire for a share in these markets from European bases—more than 170 million consumers are in the E.C.M. alone—is causing American investments in common market countries to increase.

3. The Dutch, with their age-old tradition of world trade and finance, their firm record of democracy, and their flare for industrial diplomacy, can act as a bridge between the E.C.M. and the Circle Market across which American industry, among others, may travel.

4. Holland has long had one of the world's outstanding Plastics Institutes, not only a research facility, but a repository of world plastics literature.

5. This meeting and exposition should provide a neutral meeting ground and a balanced international setting for competitive exposure by plastics industries throughout the world.

On the following pages will be found statements by three Dutch plastics authorities previewing materials (p. 154) and machinery (p. 146) at the show, and how the show is organized (p. 144). A list of exhibitors starts on p. 160. The preliminary conference program appears on p. 158.



How this show is different

By G. G. Meester

Geert Gerrits Meester *was born April 1, 1904 in Ommen, Holland. Before the war he was for many years sales manager and publicity chief of subsidiaries of American concerns in the Netherlands. In 1947 he joined N. Y. 't Raedthuys where he became a director in 1948. This company, publishers and publicity agents since 1908, was transformed by him into a specialized organization of trade and industrial fairs, among the best known being the International Packaging Exhibition. It has been held every two years since 1951, and the International Plastics Exhibition "macroPlastic" every three years.*

Advances in science and technology have created an increasing need for *specialized* exhibitions. These must be held in a limited space and must bring out features which do not emerge at *general* exhibitions. The general exhibition serves *trade*. From the very beginning, it has been a meeting place for merchants. The primary aim is *sales*. The specialized trade fair, on the other hand, serves technology, although the aspect of business is also involved. For this reason, participants in international trade fairs are especially anxious to show off the technical achievements incorporated in their products. Healthy scientific competition plays an important role in this. Exhibitors are able—and willing—to utilize the relatively neutral sphere of a specialized fair to compare, and be compared, with other manufacturers at home and abroad. Each feels a growing need to show his contribution to the development, and to observe the progress made by others.

International Congress

All the factors referred to above have been carefully studied in organizing the macroPlastic Fair, 1960. Using the first of these exhibitions—which took place in 1957—as a basis, many new ideas will be brought to fruition this year. Indeed, this is necessary because the development of the plastics industry and the discovery of new basic and ancillary materials by the chemical industry have gone ahead at such a tempo in recent years that they have outstripped developments in the processing of synthetic materials. The aim, then, is to reduce the gap as quickly as possible.

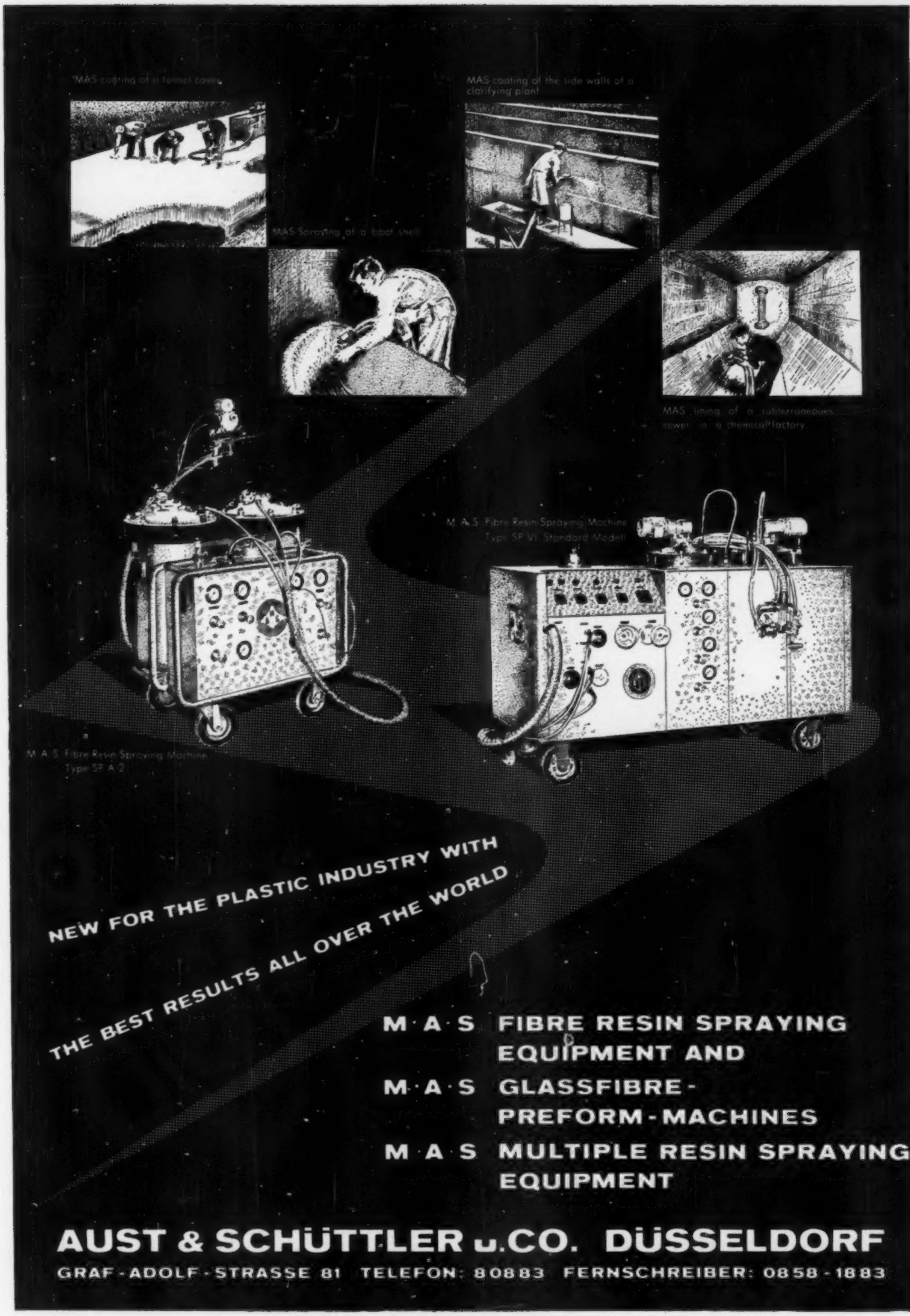
With this in mind, the International Congress 1960 on the Technology of Plastics Processing has been organized to precede the fair. This will take place in Amsterdam from October 17 to 19, and will be held under the auspices of the Association for the Advancement of the Knowledge of Materials, the Royal Netherlands Institute of Engineers, and the Royal Netherlands Chemical Association.

The Congress will deal not only with basic materials but also with the development of machinery. Hundreds of experts from all parts of the world are expected to attend, and they will have an opportunity to test the theories of the congress on the materials, machinery, and products at the fair.

The fact of the organization of the Congress and the Fair being in the same hands means that the interests of both can be served in the best possible manner. Thus Congress and Fair become complementary parts of a single unit.

How the Fair is organized

Another important point in all international exhibitions is that of surveyability, which is being threatened by the continual increase in specialized fairs. The macroPlastic exhibition is the second largest of its type in the world, and it has demanded a completely new approach. Naturally, the exhibits are separated as far as possible into groups occupying the various halls on the Utrecht fair site. A clear division is made between basic materials and ancillary materials, between processing machinery of various types, and between semifinished and finished products. This, however, does not necessarily work for ease of inspection. This can only be achieved by dividing the groups once again into *branches* of the industry. In this, it is hoped that the macroPlastic 1960 will be something of a pioneer among plastics exhibitions. Hall C, which is some 550 ft. in length, will be devoted entirely to information and instruction, the exhibits there being divided into 20 sections. There, branch for branch, the progress in plastics materials will be displayed by exhibitors whose stands are in the other halls. Moreover, as far as the immediate future is concerned, we may anticipate that this Information and Instruction Hall will become the "living catalogue" of the exhibition. Each and every sector will result from the advice, or will be under the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auspices of an unbiased non-commercial organization representative of the branch concerned. The organization of this part of the Fair is being carried out in close cooperation with the Synthetics Institute T.N.O. Delft, the State Industrial Service in the Hague and with the Advisory Committee for macroPlastic 1960. The plan has never before been realized at an international plastics exhibition, and thus the macroPlastic 1960 will take on a completely new aspect of "service to technology."

Holland as international rendezvous

A Dutch organizer of trade fairs might be expected to have difficulty in describing objectively his own country's special suitability as the site for the forthcoming exhibition. I feel, however, that the following facts—which are open to all to see—will show that the macroPlastic 1960 does not depend only upon its size, its universal character, and its surveyability for its significance.

Holland is an ideal *neutral* territory for the world's plastics industries, and one in which exhibitors can freely show and demonstrate their achievements. Our national basic chemical industry is not concentrated in any single one of the plastic material sectors included in the Fair.

Holland has long been a rendezvous in the most international sense. It possesses no inhibitions which can arouse national or protective instincts. For this reason, Holland offers an exceptionally balanced potential for an international plastics exhibition. Entries are almost equally divided throughout the industrial nations of the Western world. There is no national protectionism; there is, however, the opportunity for an objective assessment of the capabilities of the various countries in the field of plastics. Holland—the Gateway to Europe; and, perhaps, already on the way to becoming a bridgehead for the six-nation Common Market and the seven-nation Free Trade Association—can make an important contribution to international synthetics in a liberal sense. This is synonymous with the Dutch approach as manifested in other fields. Visitors from the United States will appreciate this in particular; they have always been pleased to come to Holland, particularly since the last war. The numerous examples of American investment in this country are proof. Numerous factors have played a part in attracting these investments: good communications, industrial peace, an abundance of skilled workers, relatively low labor costs, a relative absence of bureaucracy, facilities for the free transfer of profits, investment facilities, and freedom of choice of sites. Many American exhibitors and visitors will be returning to Holland in October. They can be assured of a cordial welcome and efficient service together with an interesting and stimulating congress and trade fair.

Machinery, processing at the Fair

By Dr. M. Stel

In the past five years much progress has been made in European plastics processing. Examples of this improvement will be in evidence in the macroPlastic exhibits. Here we would like to review briefly the status of plastics machinery and processing in Europe.

Thermoset molding

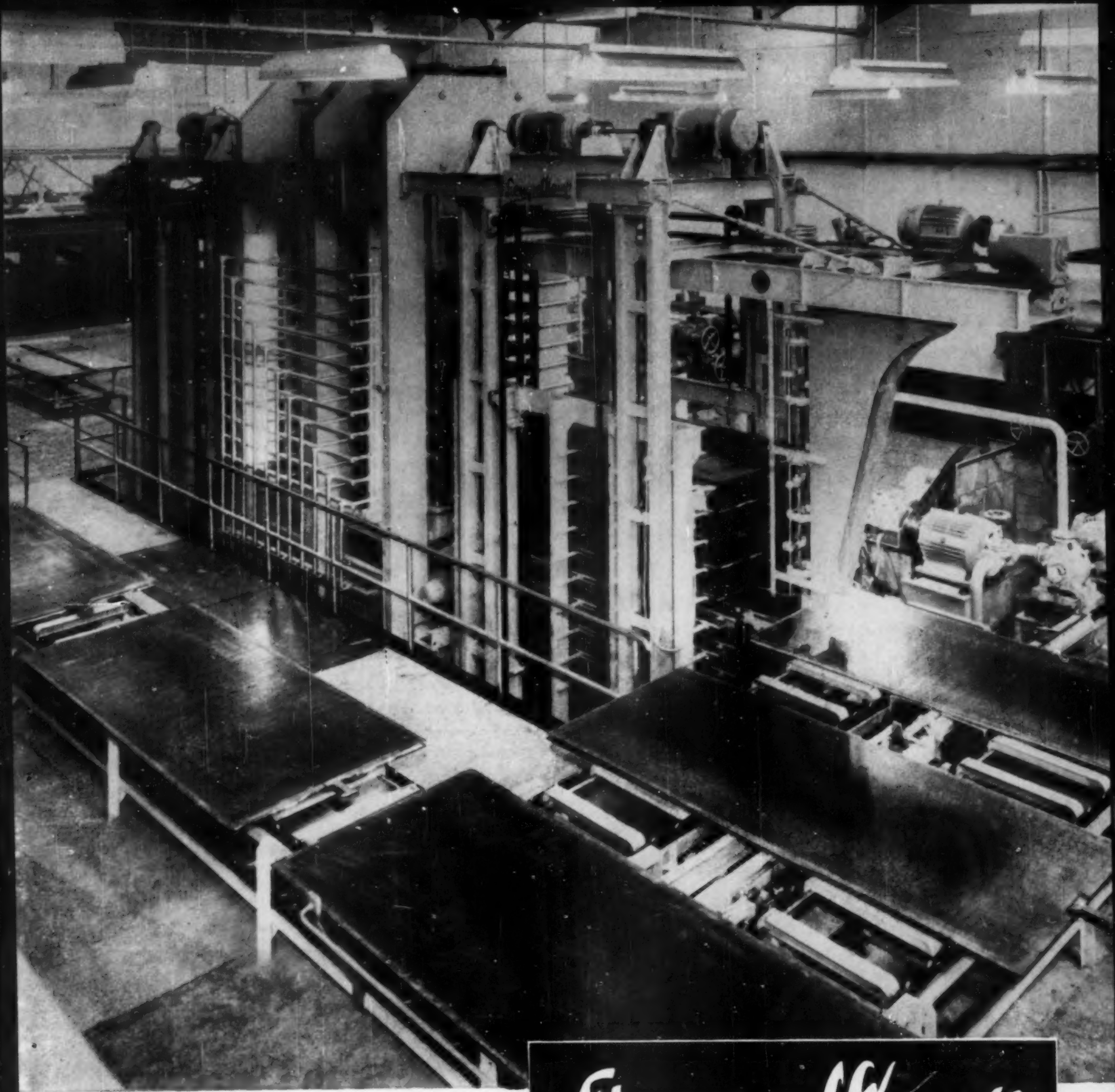
Advances in molding materials now make it possible for thermoset molding to become competitive with thermoplastic molding. But in order to realize such an aim, a number of varying conditions must be fulfilled.

First, there is need for a high level of accuracy in press design and construction, in temperature control, and in the timing of each element of the molding cycle. Today, electric heating is preferred over steam heating, mainly for reasons of temperature control. Fast molding requires optimal heated tools, for which induction heating is preferable as the heat is much more effectively spread than with common resistance heating.

Secondly, the presses must be equipped with a programmed cycle controller to permit all kinds of operations to be performed automatically.

Finally, proper mold design is essential as the higher speeds of fully automatic molding demand much greater accuracy in tool construction.

When semi- or full-automatic molding are used properly, rejects and powder losses are practically reduced to zero. One problem still remains unsolved: automatic mold- (To page 150)



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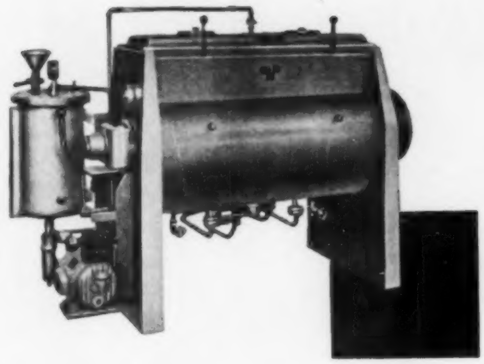

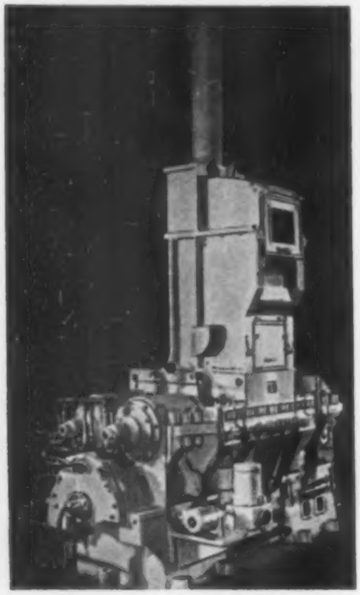

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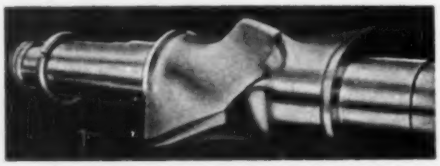
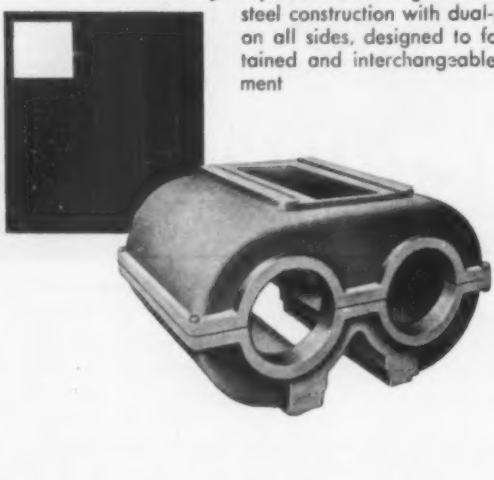
- mechanical strength provided by cast housing with replaceable mixing chamber, self-aligning roller bearings, forged steel shafts with cast rotor bodies shrunk thereon
- no bull-gear-pinion drive. Either Uni Drive or Semi Uni Drive. The latter provides power transmission to one rotor shaft only, the coupling gears being incorporated in the mixer design
- hydraulic operation of the sliding discharge door. Drop door is optional feature
- four-bladed large diameter mixing rotors perform rapid and excellent dispersion, allowing high HP input



- replaceable mixing chamber of welded steel construction with dual-purpose jacket on all sides, designed to form a self-contained and interchangeable machine element



- dust-stops between both rotor shafts and mixing chamber consists in spring-loaded floating ring seals with hardfaced contact faces and automatic lubrication
- roller bearings and special thrust load arrangements eliminate pumping action of rotor shafts

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M. Stel *was born in 1916 in the city of Groningen, The Netherlands. After completing his studies in chemistry at the University of Groningen, he spent some time as an assistant at the Agricultural High School in Wageningen. During the war he joined the N. V. Philips' Gloeilampenfabrieken in its plastic division at Eindhoven. M. Stel currently holds the position of Assistant Divisional Manager of the Plastics Division.*

ing with inserts. Much research is being done on this question today and there is a fair chance that a solution will be found soon.

Thermoplastic molding

In the thermoplastic field it is generally agreed that machine manufacturers have introduced many improvements in plasticating equipment during the past years. Although the controversy between plunger and screw preplastication has not been settled, it is quite likely that straight plunger types of cylinders will remain with us. In fact, it is believed that both types will compete with each other for some time, except for specific areas where each has an established position.

As far as the conventional plunger type is concerned, the heating cylinder and its spreader should be designed for maximum heat conduction, minimum loss of pressure in the material, and minimum contamination by overheated decomposed material. To avoid these phenomena, the inside area of the cylinder from one cross-section to the other should vary as little as possible.

Accurate temperature control will be essential to keep presses running for months on end without the necessity of removing the heating chamber for clearing decomposed material. In this connection it is common practice to have several chambers, each reserved for a given material.

Where a machine is provided with a screw preplasticating unit, it will in most cases be a more expensive item. But preplasticating systems will purge rather easily so that spare units are hardly needed. Although not yet available on a large scale, some screw-preplasticators marketed today can process practically all existing thermoplastics. In practice, screw preplasticators have proved to be very effective for the molding of articles which exhibit variations in cross section, have thin walls, or represent application where freedom from internal stresses is required.

On the other hand, the evidence cannot be ignored that a modern plunger-type heating cylinder with internal spreader heaters will remain a very useful machine from an efficiency point of view, especially for semi-technical goods requiring moderate precision.

The screw plasticator has, however, advantages as far as a better quality melt is concerned. Exact temperature control is easier. Moreover, in certain cases, material can be colored in the cylinder during molding. Finally, certain materials make it necessary to maintain under all circumstances an excess pressure in the heating chamber so as to avoid decomposition of the material. This condition, however, cannot be realized with the conventional plunger-type machine.

There is a difference of opinion concerning machines where preplasticated material has to be transferred to another plunger type chamber before being injected into the mold. It is in this chamber that a residue of material often remains, which becomes either partially mixed with the subsequent shot or attaches itself to the face of the plunger. However, some manufacturers seem to have solved this problem satisfactorily. There may be some advantages in injecting material into the mold without the preplasticating screw moving lengthwise, resulting in constant positioning of the screw in respect of the various heating zones of the cylinder.

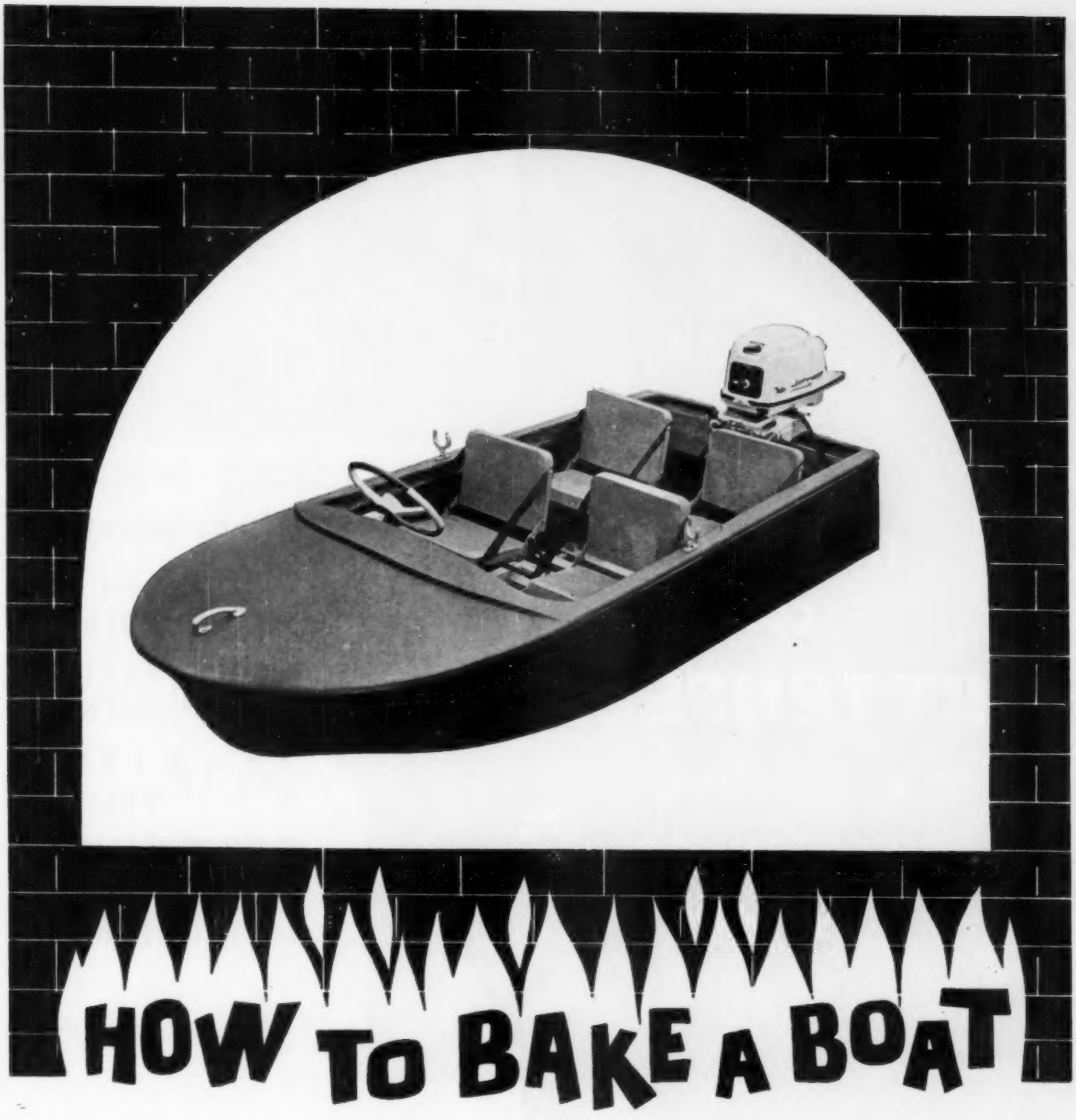
In case the material is not transferred to another chamber, but is injected directly, using screws as a reciprocating plunger, such problem is not apparent. Many manufacturers are building their machines with this in mind.

What clamping method to use is also still an open question: whether to use straight hydraulic pressure or a hydraulic system coupled with toggle action. The former, from an engineering point of view, is more costly to construct, but is definitely superior in action and control and has a considerably longer service life. This argument loses much of its importance, however, since improvements in injection machine design are so rapid that presses become obsolete before the end of the working life of the hydraulic clamp.

Extrusion

The major trend is toward the single screw type, which offers most advantages, since its mechanical heart, the thrust race, can be of sound construction. This contrasts to the twin screw machines where size becomes a limitation, since each screw has its own thrust race.

The competitive stimulus generated by the twin screw extruders resulted in extensive development work on behalf of the single screw machines, which in its ideal shape should have a high output of extrudate at low cost, accurate temperature control of screw and barrel, stepless screw speed within certain limits, a reliable thrust race, and high power output. One way to construct a compact machine at low cost is to increase the length-diameter ratio of the **(To page 154)**



Fill a coated, lined mold with powdered polyethylene. Heat in oven until a fused layer of plastic forms on the mold wall. Dump unfused material and return mold to oven. Then cool, strip and trim. That, in essence, is the Engel process...a new, low cost means of producing such items as the 10-foot pleasure boat shown above, or large plastic drums, tanks, tote boxes and shipping containers.

This one method of processing plastics opens a whole new market for millions of pounds of polyethylene resin. It is just another example of the tremendous increase in the use of plastics for appliance housings, automotive products, construction materials, furniture, luggage and hundreds of other items.

Shouldn't you be cultivating this market? The mushroom-like growth of the plastics field has generated an unprecedented demand for materials, machines, motors, tools, dies, supplies and services for making, molding and finishing plastic products. The plastics market thinks big and buys big. And the way to reach it is through the pages of MODERN PLASTICS... the dominant magazine in the field, with more editorial matter, more paid subscribers and more advertising than all other plastics publications combined.

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screw, as a consequence of which the material remains in the screw for a much longer time while, at the same time, a greater percentage of heat is imparted into the material.

The other method is to have the screw revolve at considerably higher speeds. This results in a much higher output and a steeply increased work-input of the screw, sometimes of such nature that adiabatic conditions can be established. When more viscous materials have to be processed on a high speed screw machine, it is even sometimes necessary to use water cooling along the barrel.

In search for high output, the second method holds the greatest promise since it permits construction of extruders of small proportions and large output of correctly melted material.

Materials developments in Europe

By Dr. R. Tunteler

Dr. Roelf Tunteler *was born in 1923. He is a graduate of the University of Groningen in the Netherlands, where he specialized in polymer chemistry. Since 1951 he has been engaged in chemical and processing research of polymers at the Plastics Research Institute T. N. O., Delft, The Netherlands. In 1957 he was made Director of the Institute, a position which he currently holds.*

In the past 10 years the European plastics industry has shown enormous growth. Production of thermoplastic materials in the O.E.E.C. countries[a] has risen from 86,500 metric tons[b] in 1950 to 785,000 in 1958; production of thermosets from 205,600 to 639,000 tons; and the cellulosics increased from 52,600 to 183,000 tons.

Thermoplastics

Polyvinyl chloride. In 1959, Western Europe consumed about 413,000 metric tons of PVC, approximately the same as the United States. Applications include floor covering, film, pipe, electrical conduits, and others. Quality, price, and easy processability are probably the main reasons why PVC has become so popular. The fact that rigid PVC can now be processed on injection molding machines of a novel design has increased its usefulness, so that couplings, fittings, etc., made of this type of PVC now also find a wide range of applications.

Polyethylene. Growth of PE has not been as pronounced as that of PVC. One of the major factors is very probably the patent situation. Licenses in Western Europe have been pretty scarce on polyethylene. But this situation is changing, with new processes appearing. In view of the rising demand, many installations have been built, or are under construction. Production capacity in the O.E.E.C. countries at the beginning of 1960 amounted to 274,900 metric tons. By the end of 1961, it is expected to reach 423,000 metric tons.

Polypropylene. This material will, quantitatively speaking, occupy a rather prominent place among the other thermoplasts, particularly when the somewhat confused patent situation in many European countries has become clearer and the price has gone down more.

Polycarbonates, although to a smaller extent, will also find ready sales. Bayer (Western Germany) has successfully carried out much research on these plastics. Capacity of Western Europe has so far not been impressive. But it would seem that plans to increase production by a substantial amount will shortly be realized.

Polystyrene production capacity in Europe is not as large as might be expected: in 1959 a total of about 200,000 tons was produced, compared with 400,000 in the U. S. Polystyrene producers, however, are enlarging capacity, and some chemical concerns have announced plans to build polystyrene plants. In addition, capacity for monomer production is being raised. Apart from the Euro-

[a] Organization for European Economic Cooperation, of which the following countries are members: Austria, Belgium, Britain, Denmark, Eire, France, Western Germany, Greece, Iceland, Italy, Luxemburg, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and Turkey.
[b] One metric ton = 2204.6 pounds.

Table I: Sales of plastics in the several O.E.E.C. countries in 1958 (in metric tons)

Country	Thermo-setting materials	Plastic materials	Cellulosics	Total
Western Germany	266,000	294,000	67,600	627,600
Britain	161,100	208,000	53,700	422,800
France	72,378	122,458	36,710	231,546
Italy	56,750	96,400	11,500	164,650
Netherlands	27,942	17,783	4,382	50,107
Sweden	28,700	12,400	7,400	48,500
Belgium/Luxemburg	5,000	22,000	[c]	27,000
Switzerland	[d]	[d]	[d]	21,150
Austria[b]	[d]	[d]	1,310	20,000
Norway	15,132	4,268	205	19,605
Spain	5,050	7,300	4,300	16,650
Denmark	1,200	1,000	[c]	2,200
Eire	[d]	[d]	[d]	73
U. S. A.	577,400	1,154,670	61,845	1,793,915
Total	**639,252**	**785,609**	**187,107**	**1,651,881**

[a] No figures available for the following O.E.E.C. members: Greece, Iceland, Portugal, Turkey. [b] Production figures. [c] Included under thermoplastics. [d] Unknown.

Table II: Sales of phenol- and cresol formaldehyde and amino resins in several European countries in 1958 (in metric tons)

Country	Phenol-formaldhyde and cresol formaldehyde resins	Amino resins
Western Germany	64,700	16,400
Britain	55,400	50,700
France	20,700	19,650
Italy	16,000	24,000
Netherlands	8,000	[a]
Austria	2,940	4,000
Norway	1,000	9,550
Spain	2,900	2,200
Denmark	500	[a]

[a] Unknown.

pean industries that are involved, American concerns, of course, also have a considerable share in these developments.

Cellulosics. Consumption figures seem to remain more or less constant. As a material for pipe, cellulose acetate butyrate has not been as successful in Europe as in the U. S. The main reason might be that the PVC pipe holds such a strong position. For a picture of the consumption figures, reference may be made to Table I, above.

Polymethyl methacrylate. In 1959 the production was about 60,000 metric tons. In addition to its uses as pipe, sheet, and block material, acrylics are more and more frequently injection molded, e.g., tail lights, telephone sets, phonograph records, and electric shavers. Only one new development will be mentioned in this article, that of Resart (Western Germany), who recently succeeded in producing sheet by using an extrusion process on a commercial scale.

Polyamides. This material has been made in Europe for years: the AKU (Holland) and S.A. Organico (France) make nylon-6 and nylon-11, respectively. European production capacity is estimated to be 30,000 tons/year. Confidence in this material is ever increasing. Improved processing techniques, e.g., ship propellers, with a diameter of about 1.5 m. are being produced—and a decrease of the price of the material are contributing to a steady growth.

Thermosets

Growth of thermosetting materials has not been as phenomenal as that of the thermoplastics. Nevertheless, intensive research aimed at improving these materials is currently being conducted. For example, the curing time of phenol formaldehyde resins has been considerably decreased (from about 35 to about 10 sec. per millimeter of wall-thickness). Another development is a type of phenol formaldehyde molding powder to which some melamine-formaldehyde has been added, thus enabling the production of phenolic molding powders in colors. Because of these and other developments, the thermosets will undoubtedly keep and enlarge their importance. For last available sales figures, see Table II, above.

Polyesters. In 1959 the consumption of unsaturated polyester resins for reinforced plastics amounted to approximately 40,000 metric tons. In addition these resins are still being used on a large scale in the production of lacquers. The initial expectations about glass reinforced polyesters have not been realized, mainly due to costing factors. But there are indications of future growth.

Epoxies. These resins have grown in importance both as casting and impregnation resins, as adhe-

sives and, last but not least, as a lacquer resin. However, figures of total consumption in Europe are not available.

Conclusion

The full implementation of the principles of the European common market, which briefly involve that for a very large number of products the import duties of the participating Western European countries in a few years' time will be leveled, cannot but tend to contribute to the growth of plastics. Although this leveling will not be completed when the macroPlastic Exhibition is held, this modern Fair will give a very clear picture of the current state of affairs in Western Europe.

Because several U. S. concerns will also be represented, a good idea of the progress in the U. S. will also be obtained.

Program of International Congress

Amsterdam, October 17-19, 1960

Section I: Processing techniques and principles of machine design

HERBERT GOLLER AND DR. ENG. A. KLEINE-ALBERS, *Ankerwerk Gebr. Goller, Nurnberg.*

H. DOMININGHAUS, ENG., *Farbwerke Hoechst.*

H. BECK, ENG., *BASF.*

H. C. M. SMITH, ENG., *Philips, Eindhoven.*

L. W. TURNER, *Yarsley Research Laboratories, Oaklands.*

DR. J. F. SALHOFER, *Kleinewefers Sohne, Krefeld.*

RICHARD L. BALLMAN, *Monsanto Chemical Co., Springfield, Mass.*, "Prediction of the flow of a polymer melt into a cold cavity."

B. H. MADDOCK, *Union Carbide Plastics Co., Bound Brook, N. J.*, "Pressure development in extruder screws."

ROBERT E. COLWELL, *Monsanto Chemical Co., St. Louis, Mo.*, "The response of polymer melts to shear."

R. N. WETTERHOLT, *Amcel Co. Inc.*, "The dependence of the macroproperties of blow molded objects on process and machine design variables."

Section II: Processing behavior of specific plastics

J. CH. F. KESSLER, ENG., *N. V. Research, Arnhem*, "The importance of moisture control in the processing of nylon."

J. L. VOIGT, *A. K. U., Arnhem*, "Extrusion of nylon rod."

DR. G. W. VAN RAAMSDONK, *Koninklijke/Shell Plastics Laboratorium, Delft*, "Processing of polypropylene."

L. H. KROL, ENG., *Koninklijke/Shell Plastics Laboratorium, Delft*, "Comparison of the behavior of low- and high-density polyethylene, polypropylene, and hard PVC in a single screw extruder."

BEN. P. ROUSE, JR., PH. D., *Tennessee Eastman Co., Kingsport, Tenn.*, "The control of processing variables in high speed wire coating of polyolefins."

W. R. REINBACHER, *E. I. du Pont de Nemours International, Geneva*, on methods and problems of extruding acetal resin.

DR. CHR. A. VAN GUNST, *Staatsmijnen in Limburg*, "Toughness of injection molded articles from high-density polyethylene."

DR. BAIRD, *I. C. I. Plastics Div.*, on the processing of methyl methacrylate granules and powders.

MR. BACKOFEN, *Bayer, Leverkusen*, "Injection molding of polycarbonate."

L. DIJKEMA, *Plastics Institute T. N. O., Delft.*

Section III: Miscellaneous processing techniques

K. J. BROOKFIELD, *Fibreglass Limited, Ravenhead*, "The suitability of various finishes of glass fiber with a view to the processing techniques of glass fiber reinforced materials."

DR. ING. STASTNY, *BASF, Ludwigshafen*, "The manufacture of plastics foam from polystyrene."

DR. H. A. K. EDEN, *Philips, Eindhoven.*

DR. H. P. ZADE, *Rediweld Ltd., Crawley*, "The application of some new techniques in the heat forming of thermoplastics for the construction of chemical plant."

B. VAN ROOIJEN, *Aust & Schuttler, Dusseldorf.*

DR. RUDOLF KLEINSTEUBER, *Henschel-Werke, Kassel.*

MR. KEESEN, *Bayer, Leverkusen.*

List of exhibitors, p. 160 ►

Exhibitors at macroPlastic

Alphabetical listing

Where no country is indicated, the exhibitor is headquartered in the Netherlands

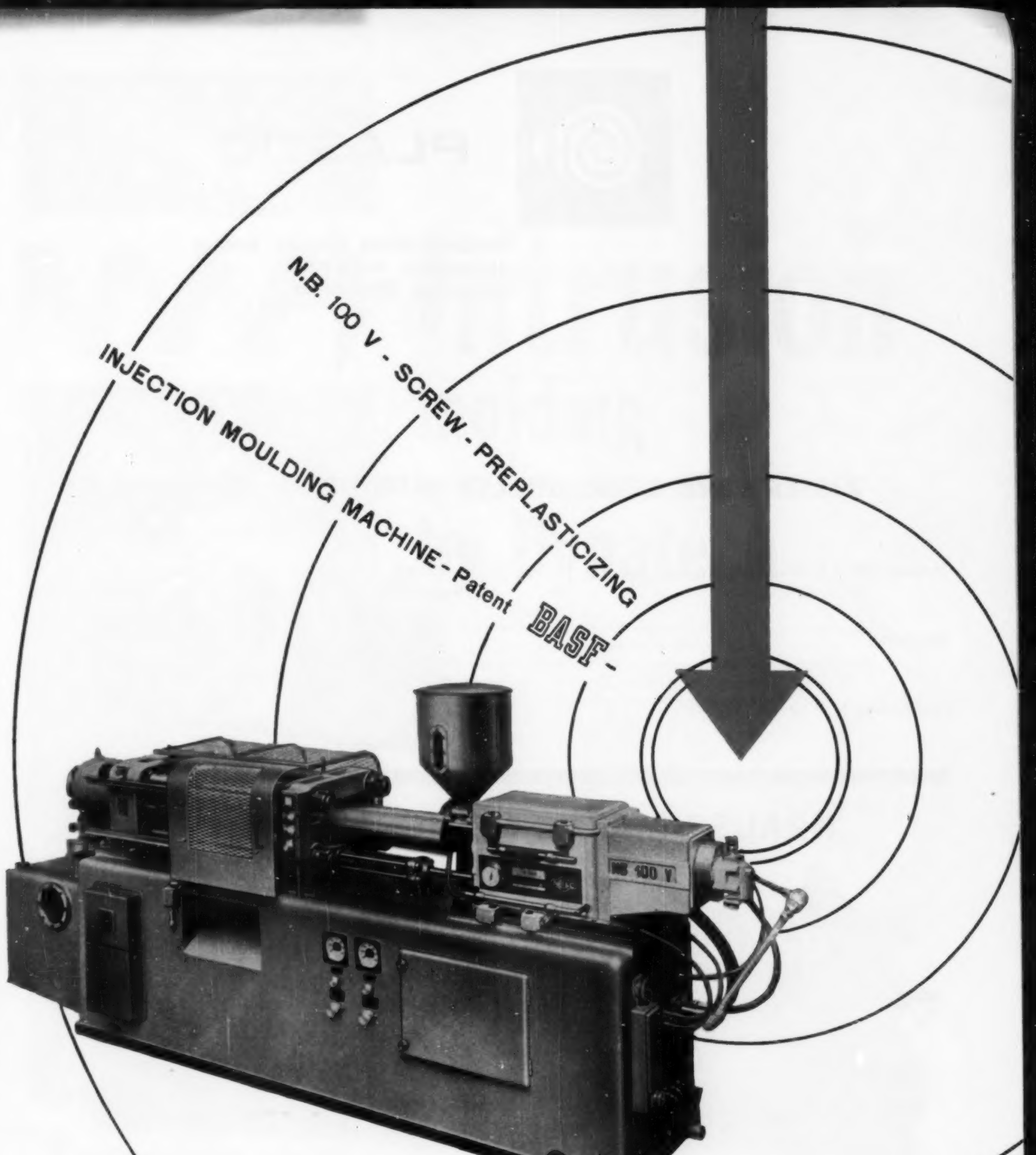
Acella J.H. Benecke, Hannover, Germany
Activit N.V., Amsterdam
Agfa Photo, Arnhem
Albracht N.V., Utrecht
Alewijnse & Co. N.V., Nijmegen
Algemene Kunstzijde Unie N.V., Arnhem
Alkor Werke G.m.b.H., Munchen, Germany
Allard Kunstoffen & Technica N.V., Amsterdam
Allied Chemical Corp., New York, U.S.
Alplastic, Tisselt, Belguim
Amcel Co. Inc., London, England
Amcel Co. Inc., New York, U.S.
American Cyanamid Co., New York, U.S.
Ankerwerk Gebr. C., Nuremberg, Germany
Argus Chemical N.V., Drogenbosch, Belgium
Aristodex Kunstofbuizenfabriek, Rotterdam
Ateliers Belges Reunis S.A., Familleureux, Belgium
Atemo S.A., Brussels, Belgium
Atlan Werk Ludw. Sattler K.G., Muhlacker, Germany
Aust & Schuttler u. Co., Dusseldorf, Germany
Austria Handel Mij, Amsterdam
Austrovac, Vienna, Austria
Avery Adhesive Lable Corp., Monrovia, U.S.
Avoplast, Amsterdam

B.I.P. Chemicals Ltd., Oldbury, England
B.I.P. Engineering Ltd., Birmingham, England
B.X. Plastics Ltd., London, England
Bach Jr., Firma J. A., Ermelo
Backer's Compressoren N.V., Amsterdam
Bakelite Ltd., London, England
Bandera, Luigi, Busto Arsizio, Italy
Barmag Barmer Machinen A.G., Remscheid/Lennep, Germany
Battenfeld Masch. Fabr., Meinerzhagen, Germany
Battenfeld-Nederland N.V., Amsterdam
Bauermeister G.m.b.H., Hamburg/Altona, Germany
Bayerische Wollfilzfabrik A.G., Olfingen/Donau, Germany
Beccon, N.V., Doetinchem
Behrmann N.V., Amsterdam
Belmoplast S.A., Brussels, Belgium
Bergh & Metz, N.V. van den, Amsterdam
Bergkamen A.G., Chem. Werke, Bergkamen, Germany
Birkholz & Co., Heppenheim a.d.B, Germany
Bitzer, Hugo, Reichenbach, Germany
Bouwman's Internationale Verkoopporg N.V., Amsterdam
Briegleb, Gust., Amsterdam
Brilliant Plastics N.V., Amersfoort
British Celanese Ltd., London, England
British Combined Stand
British Plastics Federation, London, England
Buchsbaum N.V., The Hague
Buhler, Gebr., Uzwil, Switzerland
Buss A.G., Basel, Switzerland

Canadian Chemical Co. Ltd., Montreal, Canada
Canadian Resins and Chemicals Ltd., Montreal, Canada
Catalin Corp. of America, New York, U.S.
Chemicalien Im- & Export Mij, Amsterdam
Chemisch Fabriek Synres N.V., Hoek van Holland
Chemische Fabriek N.V., v/h Dr. A. Haagen, Roermond
Chem. Werke Albert, Wiesbaden, Germany
Chem. Werke Huls A.G., Marl, Germany
Ciba N.V., Arnhem
Cie. Gen. Belge des Isolants S.A., Amsterdam
Cobenam, Antwerp
Cogebi S.A., Lot/Brussels, Belgium
Colasit Holland N.V., 's Hertogenbosch
Comptoir des Fers & Metaux S.A., Luxemburg
Comptoir des Mataux, Overpelt, Belgium
Coroplast Fritz Muller A.G., Wuppertal, Germany
Cosden Petroleum Corp., Big Spring, U.S.
Costruzioni Meccaniche G.B.F., Bresso—Milan, Italy
Coudenhove, Vienna, Austria
Covema s.rl., Milan, Italy
Daniels Ltd., T.H. & J., Stroud, England
Danish Plastics, Copenhagen, Denmark
De Brouwers & van de Stadt N.V., Amsterdam
De Veendammer Perserij N.V., Amsterdam
DeVogel v. Calcar N.V., Zwolle
Defa N.V., Amsterdam
Delft, N.V. Lijm- & Gelatinefabriek, Delft
Deutsche Advance Produktion G.m.b.H., Cologne, Germany
Deutsche Tafelglas A.G., Furth, Germany
Dikkers & Co., N.V., Rengelo (O)
Dohm Ltd., London, England
Dow Corning Corp., Midland, U.S.
Draka Plastics, Amsterdam
Dreher Maschinenbau, Aachen, Germany
Driel, J.W.v., Utretcht
Du Pont de Nemours, Geneva, Switzerland
Durapipe Fittings, Ltd., London, England
Dynamit A.G., Troisdorf, Germany

Eastman Chemicals Inc., Kingsport, U.S.
Eckert & Ziegler G.m.b.H., Weissenburg, Germany
Edilon N.V., Haarlem
Egan, F. W., Somerville, U.S.
Electro Zuur- & Waterstoffabr. N.V., Amsterdam
Elmex, N.V., Rotterdam
Emergo, Landsmeer
Engel, Schwertberg, Austria
Eriks Pakking & Rubber N.V., Alkmaar
Ernstmeir A., Herford, Germany
Eyle & Co., v., Vlaardingen

Fabelta, Brussels, Belgium
Fabr. v. Chem. Prod. Saba, Dinxperlo
Fabr. v. Persplatic Gebr. v. Niftrik N.V., Putte
Facon & Cie, Paris, France
Farbenfabriken Bayer A.G., Leverkusen, Germany
Farbwerke Hoeschst A.G., Frankfurt, Germany
Fatege, Kirzinger & Co. G.m.b.H., Neustadt, Germany **(To page 164)**


N.B. 100 V - SCREW - PREPLASTICIZING
INJECTION MOULDING MACHINE - Patent BASF -
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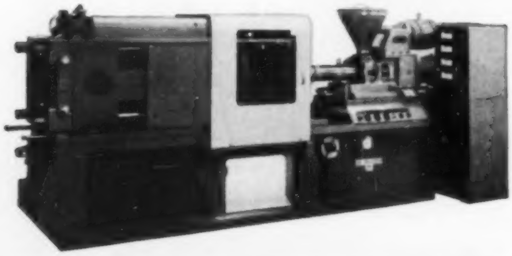

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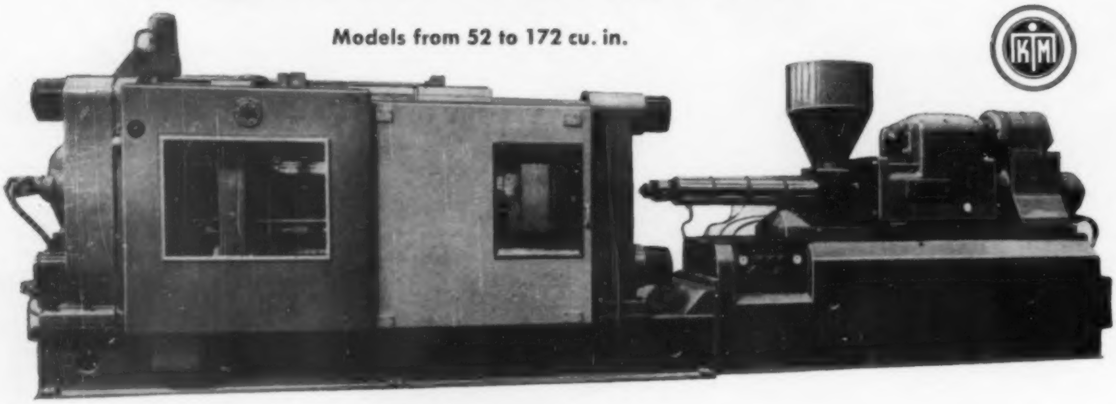

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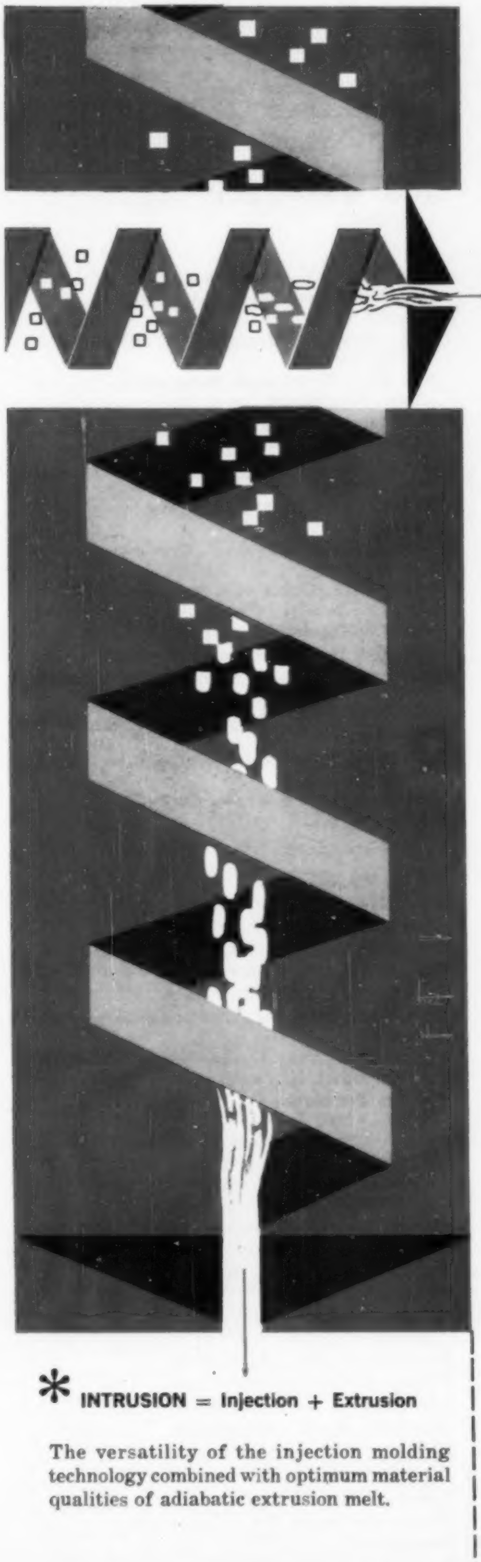

Exhibitors at macroPlastic from p. 160

Fellner & Ziegler G.m.b.H., Frankfurt, Germany
Ferminjec, Deurne, Belgium
Ferro Enamels (Holland) N.V., Rotterdam
Fijnhout & Tripleximport N.V., Amsterdam
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Flesch, P., Ludenscheid, Germany
Floor Treatments Ltd., High Wycombe, England
FNET, Moncalieri, Italy
Folkard Ltd., J.S. & F., London, England
Foster Grant Co. Inc., Leominster, U.S.
Frese & van Beusekom, Heemstede
Frieseke & Hoepfner G.m.b.H., Erlangen

Geveke & Co., Amsterdam
Goppinger Kaliko u. Kunstlederwerke, Goppingen, Germany
Groningen, N.V. Kunststoffenmij. Groningen
Grussen, Ets. J.P., Paris, France

Haagen N.V. Chem., Fabriek, Roermond
Haagen & Rinau, Bremen, Germany
Haarlemsche Bouwstoffenhandel N.V., Haarlem
Hagedorn & Co., Osnabruck, Germany
Hahn & Kolb, Stuttgart, Germany
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Halstead Ltd., James, Manchester, England
Handelmij Rokker N.V., Rotterdam
Handelmij: Vaessen-Schoemaker N.V., Deventer
Handelsafd. G. Bikkers & Co., N.V., Hengelo
Handelsondern. De Nieuwe Weg, Den Haag
Havry C.V., Loosduinen
Helffer N.V., Amsterdam
Helmondse Textiel Mij, Helmond
Helvoet N.V., Nylonindustrie Nieuw-Helvoet
Heybroek & Co's Handelmij N.V., Amsterdam
Hicon N.V., Scheveningen
Hoekstra, N.V., Utrecht
Holl. Casolithwerken N.V., Leeuwarden
Holl. Gummifabriek N.V., Weesp
Holzschuher K.G., Wuppertal, Germany
Homann A.G., Fritz, Dissen, Germany
Hoechst Holland N.V., Amsterdam
Hoekstra N.V., Utrecht
Holland-Triplex Import N.V., Rotterdam
Hollandsche Papier Industrie N.V. De, Amsterdam
Hollandse Plastic Industrie N.V., Rotterdam
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Hysol Corp., Olean, U.S.

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Isoverbel N.V., The Hague
Isovolta, Vienna, Austria

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Kleefstoffenfabr. N.V., Gebr. Struyck, Zutphen
Kleinewefers Sohne, Krefeld, Germany
Kon. Noury & v/d Lande N.V., Deventer
Koop N.V., Tech. Handelmij, Amsterdam
Kornelis Kunsthars Prod. Ind. N.V., Steenwijk
Korting Radio Werke G.m.b.H., Grassau, Germany
Kunstofbuizenfabriek Aristodex, Rotterdam
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Leeuwen Buizen, N.V. van Zwijndrecht
Leister, Karl, Solingen, Germany
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Polymeric N.V., Utrecht
Polva—Nederland N.V., Enkhuizen
Ponnoplastic, Amersfoort
Premier N.V., Loosduinen

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Radyne Radio Heaters Ltd., Wokingham, England
Raschig, G.m.b.H., Ludwigshafen, Germany

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Regamey & Cie, Paris, France
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Reifenhauser Maschinenbaue, Troisdorf, Germany
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Sommer Nachf; Dr. Ing. F., Ludenscheid, Germany
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Stokvis' Textielmij N.V., Amsterdam
Stokvis & Zonen R.S., Rotterdam
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Struyck N.V., Kleefstoffenfabr. Gebr., Zutfen
Stubbe, Maschinenfabrik A., Vlotho, Germany
Syncoglas N.V., Zele, Belgium
Synprodo N.V., Wychen
Synres, N.V. Chem. Inc., Hoek v., Holland

Tamboer & Co. N.V.
Techema N.V., The Hague
Tech. Bureau Reputabel, Weesp
Technische Handelmij Edilon N.V., Haarlem
Tech. Handelsond Meypers, Haarlem
Technoplast, Monster
Technoplastic C.V., Amsterdam
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Thomassen & Drijver N.V., Deventer
Thovip, Amsterdam
Titaan N.V., Rotterdam
Triplexhandel RET, Utrecht
Triulzi A., Milan, Italy

Ulbrich & Co. N.V., Amsterdam
Union Carbide Europa S.A., Geneva, Switzerland
Union Chimique Belge S.A., Ruisbroek, Belgium

Vaessen—Schoemaker N.V., Deventer
Van Leer's Vatenfabrieken N.V., Amsterdam
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Van Oldenbeek & Smelt, Waalwijk
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Veritex N.V. Kunstlederfabr. Nw., Milligen
Verkoopass Overtoom N.V., Amsterdam
Ver Plastic Verkoopkantor N.V., Zeist
Versteege, A.J., Zandvoort
Vetterlein, W. Offenbach/B., Germany
Vogel van Calcar, N.V. De, Zwolle
Vogt & Hartmann, Mainz, Germany
Volkers, Firma L.J., Amsterdam
Vos & Co., N.V. Handelmij, 's-Gravenhage

Waal & van Overzee, Amsterdam
Watson-Stillman Press Div., Farrel-Birmingham Co. Inc., Rochester, U.S.
Wavin N.V. Ind. Ond, Zwolle
Weber, Firma, Rotterdam
Wenigmann Maschinenfabrik, Heinrich, Haan, Germany
Werkmetaal N.V., Amsterdam
Werkplastic N.V., Rijswijk
Werkspoor N.V., Amsterdam
Westag, Westdeutsche Sperrholzwerke A.G., Wiedenbruck, Germany
West Instrument Ltd., Brighton, England
Wilhelm Plasticfabriek, Amsterdam
Williams Ltd., Hounslow, England
Wilmod Compagnie N.V., 's-Gravenhage
Windsor Ltd., R.H., Chessington, England
Woestenburg & v.d. Meer, Zaandam

Zaanchemie N.V., Zaandam.
Zimmer Plastic Masch. G.m.b.H., Offenbach/M., Germany—**End**

NEW DEVELOPMENTS

Many minds at work on new ways to use plastics, new designs, and new product concepts offer ideas you can use.

Small styrene parts—large economies

When a small slotted polystyrene holder for printed circuit boards is priced at 10¢, and its machined metal counterpart at 20¢, the economics may seem, at first glance, insignificant. But when a single computing machine uses from 6000 to 20,000 of these items, the cost savings are truly meaningful—up to $2000 in the production cost of one single computer!

In addition to the attractive cost factor, the molder of the plastic holders, Space Products Inc., North Long Beach, Calif., selected high-impact polystyrene for dimensional stability and resistance to bending stresses which might affect the ease of insertion and removal of the printed circuit cards. The suitability of the material to close tolerance work was another factor; tolerances of ± 0.005 in. are maintained throughout the overall molding, and a closer tolerance of ± 0.002 in. is held inside the slotted section of the polystyrene holder.

The component is injection molded in four cavities on a 10-oz. Reed-Prentice machine. Polystyrene molding material is Dylene 800, supplied by Koppers Co. Inc. Each slotted holder has two integrally molded nodules, which snap into holes in the metal card rack, and flattened end projections, which are designed to fit into the rack's top and bottom guide rails.

At the present time, six standard sizes of holders are produced, but Space Products is now prepared to make them in any size to customer specifications. Weekly production of the standard-size holders is between 20,000 and 24,000 units. Largest of the standard holders measures slightly less than 5 in. in length and weighs only 14 grams.

Space Products is currently supplying card racks with the plastic holders to more than 30 customers, primarily in the booming electronic computer field. Perhaps the most extensive application today is in the airborne and ground control equipment used by both military and private organizations. The company emphasizes, however, that any manufacturing concern which uses printed circuit boards can profitably employ the styrene holders, thus the future potential of these small components appears to be dependent upon increasing usage of printed circuit by *all* segments of industry.

POLYSTYRENE card holders, with sprue and runners still attached, are shown in opened four-cavity mold.

OPERATOR snap-fits finished card holders into top and bottom holes in metal rack; 50 holders fit in rack.

Thermoformed PE hats

Stylish sunhats, made by American Atlas Corp., Richmond, Va., are vacuum formed from sheet of both low- and high-density polyethylene compounded with an ultraviolet inhibitor. This additive not only protects the PE hats from the deteriorating effects of strong sunlight, but also permits the wearer to tan without burning.

The hats are produced in two basic sizes. The smaller have a brim width of 16 in. and a crown height of about 4 inches. They are made of low-density Tenite PE sheet, supplied by Eastman Chemical Products Inc. The larger hats have a brim width of 28 in., with crowns up to 6 in. high. In order to provide more stiffness to the wider brims of these models, high-density Fortiflex PE, supplied by Celanese Corp. of America, is used.

WIDE-BRIMMED SUNHATS are formed from high-density polyethylene sheet, with UV absorber added to promote tanning without burning. Smaller hats, in low-density PE, are also available.

The sunhats are thermoformed with male plug assist, by American Atlas, using equipment of its own manufacture. Various female molds are used, each designed to impart a different straw-like texture. Depth of draw ranges from 4 to about 7 in., and forming time is about 20 seconds. Sheets used for forming are 72 in. wide, and vary in thickness from 10 to 50 mils.

The hats, weighing approximately 4 oz. each, are available in a wide range of colors. Retail price for a small hat is $3.95, while a large hat is priced at $7.95. For those who don't want a tan, opaque models are available.

Foamed-in-place buoyancy for boats

Flotation chambers which boatsmen will not be tempted to use as extra storage lockers, and which will not lose buoyancy through leaks and punctures, are a major feature of new 16-ft. RP boats developed for rescue and patrol work by the U. S. Coast Guard, and built at the USCG yard at Curtis Bay, Md.

The bow flotation unit is rigid urethane foam made **(To page 170)**

NEW DEVELOPMENTS

(From page 168)

from a polyester prepolymer blown with Du Pont's Freon fluorinated hydrocarbon. This mixture was supplied by Pittsburgh Plate Glass Co. Installation is accomplished by pouring 7 lb. of foam mixture behind a temporary bulkhead. After the mixture has foamed up to fill the 4 cu. ft. area, the bulkhead is removed, leaving the foam adhering firmly to the sides of the hull. The rigid foam has a density of 1.75 lb./cu. ft. Since the Freon is retained in tiny cells of the foam, it is not subject to loss by puncture or leakage—major drawbacks of air tanks.

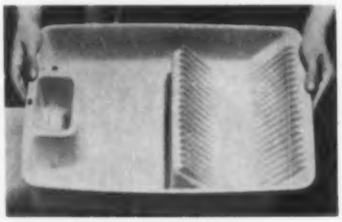
The hull structure of the boats is of epoxy resin over glass fiber fabric. Capable of being trailer-hauled, and rated for six passengers under normal operating conditions, the boats will support 700 lb. of dead weight when completely awash. They will ultimately replace three other small boat types now used by the Coast Guard for ocean, lake, and river rescue and patrol work, as well as flood relief.

High-density PE in housewares

Evidence continues to accumulate that high-density polyethylene is moving in strongly on the housewares market.

Among the latest applications to prove this point are the two products illustrated here. One is a 2-qt. combination shaker-pitcher, the other a combination drainboard and tray. Both are injection molded of Grex high-density resin produced by the Polymer Chemicals Div., W. R. Grace & Co., Clifton, N. J.

The pitcher is produced by Plastray Corp., Walled Lake, Mich., and retails for $1.49. Widemouthed for



easy introduction and dispensing of liquids, the pitcher comes with a threaded screw-on cover and a graceful molded-in spout. It is suitable for both hot or cold liquids.

The dish drainer, designed by Walter Dorwin Teague Assocs., is manufactured by Columbus Plastic Products Inc., Columbus, Ohio, and retails for $3.95. A strong competitor to the plastisol-coated wire dishrack of conventional design, the new unit is engineered to eliminate the need for a separate drain pan.

The drainer has an ingenious system of plate supports across the back end of the pan, deep sides to prevent splashing, and sufficient capacity to handle 18 plates of any size. Two rows of ½-in. fins, placed at 45° angles, hold the plates in position. The remainder of the unit can be used for glasses, cups, and other utensils. A front compartment (left in photo above) holds silverware, and long side-gutters accommodate long knives and platters.

Both products come in a range of colors.

For booth protection

By equipping toll booths with a shaped Rohm & Haas Plexiglas methacrylate shield to protect collector-operators during inclement weather, the New Jersey Garden State Parkway Authority has halved the number of heaters required in the 28 stations so far equipped, and measurably reduced operator colds, dry skin, and other ailments caused by standing in drafts. In addition, the shield keeps the toll equipment dry and thereby facilitates paper work in the booth.

The shield, plus its framework, measures 32 by 36 in. overall. Weight is 5 pounds. Application of this shield is foreseen for military sentries, plant guards, parking lot supervisors, ticket takers, and others.

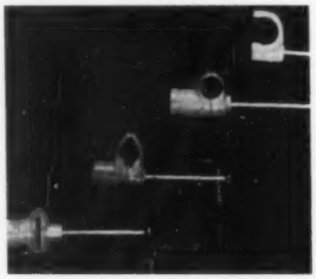
Plexiglas was chosen because of its transparency, ease of forming, outdoor durability, and resistance to breakage. Such resistance is doubly important in booth applications because employees work so close to the shield.

The shield, spring loaded, rides in a 16-gage aluminum sheet metal framework approximately twice its length and locks in the upper, or out of the way, position above the toll booth door when the shield's lower spring seats against a slight offset in the framework. When lowered, the heated air, which has risen to the top of the toll booth, can escape only by going down under the shield and out the gap between the bottom of the shield and the top of the Dutch door. Thus the shield cuts down on the amount of air flowing out of the booth, reducing heat loss.

The units are manufactured by the Industrial Metal Fabricating Co., Wayne, N. J. A 72- by 36- by ¼-in. sheet is vacuum molded to 11-in. depth (corresponding to the bow on the booth's Dutch door) and then cut in half to form two shields.

Stand-off clips

Developed in Europe and now available in this country through Harry Serwer Inc., New Rochelle, N.Y., Roka clips of impact polystyrene permit easy fastening of electric and lead-in wire to baseboards, studding, walls, etc. Molded-in case-hardened nails protrude for ham-



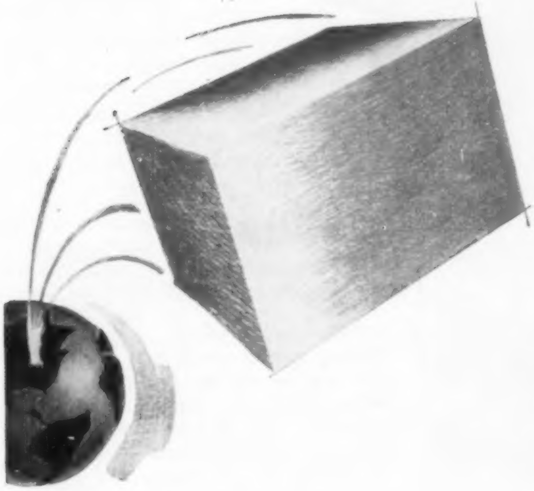
mering and pass through the clip at time of installation without contacting the electrical conductor. The clip itself can have its opening widened or narrowed to accommodate the wire by simple hand pressure. Retail prices range from $1.05 per hundred for ⅝- or ¾-in. nail and $^{5}/_{32}$-in. opening to $2.29 per hundred for a 1⅜-in. nail and $^{1}/_{16}$ by $^{7}/_{16}$ opening. Clips come packed in PE bags for rack sale.

Prepreg repairs ductwork

A polyester-saturated glass mat covering, applied directly over corroded galvanized iron ductwork in a Midwest plating plant, reduced labor costs almost 75% by eliminating the need for tearing down and replacing the corroded sections.

A total of 2500 ft. of (To page 172)

There's no *Pace** like foam



... or how to keep up with a fast-moving industry

New developments in the mushrooming field of urethane foams come fast and furious. It seems like every time you light your bunsen burner, someone has found another use for these versatile materials, or another way to improve them.

How, then, can anyone keep up with all these new developments? The answer is that nobody can. No single company can either, for that matter.

But that doesn't stop us at Wyandotte from trying. Our modern urethane laboratories are literally frothing with activity. Developing new molecules. Rearranging old ones. Testing foams.

Triols bring changes

Take polyether triols, for example. These materials have brought extensive changes in the technology of one-shot flexible foams. Our own Pluracol® Triols, a series of polyoxypropylene derivatives of trimethylolpropane, have increased load-bearing properties, improved compression set, and made possible high impact-absorbing characteristics.

Rigid foams prepared using these triols exhibit good dimensional stability, high closed-cell content, good heat resistance, low water absorption, and high compressive strength at low densities.

A useful catalyst

Or take urethane catalysts. We have a continuing research program under way on the effects of catalysts in urethane reactions.

Our own Quadrol®, for example, has proven to be an excellent catalyst and cross-linking agent. It is highly reactive . . . its four hydroxyl groups provide multiple cross-linking sites. Its two tertiary nitrogen atoms provide catalysis for the reaction. Quadrol is infinitely soluble in water, exceptionally stable to heat, and has a relatively low order of toxicity.

* * * * *

Would you like to keep abreast of these and other developments at Wyandotte? If so, drop us a line, giving as many details as possible about your requirements. *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Offices in principal cities.*

In addition to those products mentioned above, Wyandotte's urethane-foam raw materials include Pluracol Diols, used for prepolymer-type flexible foams and to impart strength properties to one-shot flexible foams; and Tetronic® Polyols for improved resilience and moldability.

Wyandotte CHEMICALS

MICHIGAN ALKALI DIVISION

PACING PROGRESS WITH CREATIVE CHEMISTRY®

ductwork was repaired at \$3/sq. ft., including material and labor. In the past, material cost alone for galvanized pipe ran from \$2 to \$2.50/sq. ft., and replacement was required every 2 to 5 years.

The corroded ductwork was first painted with polyester resin, then wrapped with two layers of resin-impregnated glass mat. A finishing coat of polyester was brushed over this covering. Resin gel time was about 30 min., and final cure about 2 hr., both at room temperature.

The covering not only repairs the existing duct, but will ultimately replace it. This will occur as corroded particles fall from the galvanized pipe and are removed through the ventilating system.

The duct repair technique was developed by Heil Process Equipment Co., Cleveland, Ohio. The polyester resin, Atlac 382, was supplied by Atlas Powder Co., Wilmington, Del.

Phenolic-handled cutter

Combination pastry cutter and serving spatula from Foodco Appliance Div., Kitchen-Quip Inc., Waterloo, Ind., consists of vertical and horizontal steel blades individually set into black phenolic handles. The

handles are compression molded in two pieces around bottom ends o the blades, then joined by a meta hinge. Molder is Wayne Plastic Corp., Fort Wayne, Ind., which use phenolic molding compound supplie by Durez Plastics Div., Hooke Chemical Corp., N. Tonawanda N. Y. Retail price of the cutter-server is \$2.98.

Vinyl film in surgery

Clear vinyl film, 0.002 in. thick, is used in many hospital operating rooms as a skintight drape over the patient to keep pus-forming bacteria sealed off from the surgical incision. The film is replacing the use of towels and other porous materials that have never been fully effective.

Prior to the operation, an adhesive is sprayed on the skin of the patient in an area surrounding the

incision. The film is sterilized in an autoclave and fitted to the body. The surgeon then makes his incision directly through the vinyl film. The drape will adhere to the skin for many hours, but can be peeled off easily when the operation is over. It may be removed before suturing, or the doctor may sew up the incision right through the vinyl film.

Use of this technique in brain surgery has the advantage of leaving the patient's face clear for observation by the anesthetist. The film is also less bulky and closer fitting than traditionally used toweling in operations on rounded body areas such as arms, legs, and neck.

The film is supplied in 24- by 42-in. size, interlayed with paper and rolled by Aeroplast Corp., Dayton, Ohio. It is manufactured by Union Carbide Plastics Co., New York, N.Y.

Reinforced Teflon gaskets

Reinforced fluorocarbon resin, selected for its good dimensional stability under compression and temperature variations, serves as gasketing for the plate glass viewing ports in a pressurized welding fixture used by The Martin Co., Nuclear Div., Baltimore, Md.

The gasketing material, Duroid 5813, produced by Rogers Corp., Rogers, Conn., is a combination of fluorocarbon resin (Du Pont Teflon) and glass microfibers in an 85 to 15 ratio. It is fitted around the periphery of the heavy plate glass and comes into contact with both the glass and its circular metal frame.

The glass can be securely sealed in the frame by tightening a frame nut. Under this compression, the dry-lubrication property of the Teflon prevents binding stress between glass and frame which might cause cracking of the glass.

The glass microfibers, encapsulated within the resin, add strength and increases the resistance of the gasketing material to the varying temperatures set up during welding.

Dogwood shuttles to plastic laminates

Strong economic reasons are leading to a growing switch from wood to plastic laminates for shuttles in the country's weaving mills.

According to Southern Shuttles Div., Steel Heddle Mfg. Co., Greenville, S. C., leading manufacturer of all types of shuttles, penetration of the plastics shuttles has reached 20% of its shuttle production and may soon go over 50 percent.

The reasons are obvious. Dogwood shuttles require replacement three to four times a year (average life is 14.3 weeks); (To page 174)

the plastics shuttles last approximately 1 year (average life is 47.7 weeks). Initial cost for dogwood shuttles is about $4, for plastics shuttles it comes to $8. Considering price and service life together, this amounts to a net saving of $4 per shuttle per year. There are an estimated total of 415,000 to 425,000 broadlooms in this country, each using one shuttle. At full penetration, the switch to plastics shuttles would result in an industry-wide potential saving of over $1.5 million annually. One mill has reported actual savings of $3400 per year.

Plastic shuttles weigh slightly more than the dogwood variety (17½ oz. vs. 15 oz.), which has resulted in some complaints from textile mills. However, most of these have been overcome by proper loom adjustment.

Wall sections of the shuttles are reinforced with multiple laminations of fabric-based resin, while the center portions are molded with reinforcements of resilient macerated or chopped fabric. Shuttles are machined to final dimensions by the Southern Shuttles Div., from molded Micarta blocks supplied by the Micarta Div., Westinghouse Electric Corp. (See also "New loom shuttle," MPl, July 1959, p. 138.)

. . . And in brief

• Called the Dy-O-Rama, a 46- by 48-in. landscaped HO model railroad layout is now being molded from Koppers Dylite expandable polystyrene by Life-Like Products Inc., Baltimore, Md., at $24.95, complete with track. It can easily be carved to modify the original scene.

• Vinyl permanently bonded to an aluminum extrusion provides molding trim to match vinyl fabrics. Shapes are available to meet all wall and partition requirements, and also for horizontal applications. Made by Keller Product, Inc., Manchester, N. H.

• Rubber suction hose, reinforced with a spiral of W. R. Grace's Grex high-density polyethylene is designed for use in industrial applications where dust and gas tend to create an explosive situation. Polyethylene replaces conventional wire reinforcement, eliminating danger of sparks from exposed wires. Hose is produced by Goodall Rubber Co., Trenton, N. J.

• Plexiglas "igloo" protects titanium metal from the atmosphere when it is being welded. At Solar Aircraft Co., hemispherical acrylic enclosures, fitted with gloved armports through which the welder can work at whatever angle the operation requires, are fitted to a base plate. After the titanium parts are placed in the chamber the inside air is replaced with argon gas, and the welding operation may then proceed without difficulty.

• Seamless reinforced plastic tanks are offered by Structural Fibers Inc., Chardon, Ohio, in these sizes: 6 in. dia. by 32 in. in height, 8 in. dia. by 36 in., 10 in. dia. by 48 in., and 13 in. dia. by 54 inches.

All sizes are rated for pressures up to 500 p.s.i.

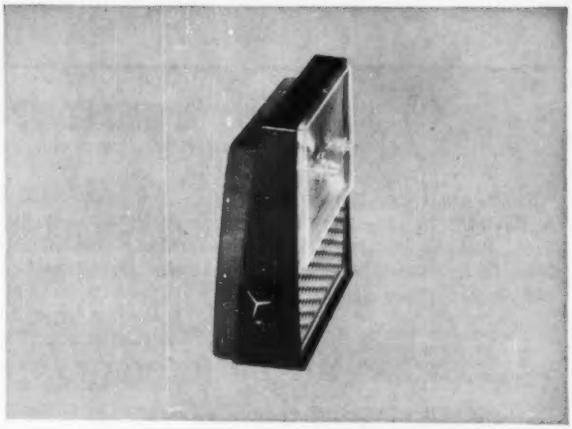
• The problem of plastic tubing pulling out of conventional flared or compression fittings, mainly due to "cold flow," is claimed to have been eliminated by the insert-collet locking action of Viseal, a new brass fitting designed specifically for plastic tubing. Manufacturer of the fitting is Commonwealth Brass Corp., Detroit 8, Mich.

• Vacuum formed Plexiglas boat windshield with built-in wing vents has been announced by Premier Plastic Mfg. Co., Minneapolis, Minn. Chromed aluminum top trim and vent molding is factory installed. White vinyl plastic deck channel gasket and deck mounting brackets are also provided. Nylon boat-top clips are easily snapped in place over the top of the windshield trim edge or taken off as desired.

• Open-end acorn lock nuts made from Delrin have been developed by Russell, Burdsall & Ward Bolt and Nut Co. for lawn furniture, toys, hotel luggage racks, aluminum tubing products and similar light duty applications where corrosion resistance and reusable locking action are desirable. Said to cost about one half the price of aluminum acorn lock nuts, the Delrin nuts are available in metallic gray to blend with aluminum, metallic gold, and natural or off-white.

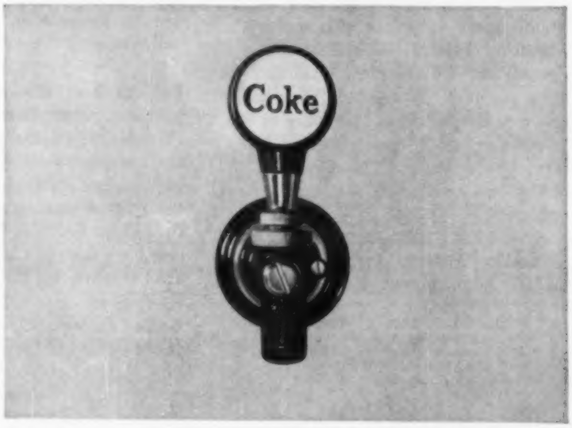
• New nylon fastening devices called Plasti-Grommets are said to offer opportunities for substantial cost savings in mass-assembly applications. They are self-retaining blind screw receptacles that are easily snapped in place and they lock tight. Typical applications include fastening the chassis of a TV set to metal cabinets; mounting a freezing unit to the inner liner of a refrigerator; or as a license plate fastener that won't corrode, etc. Made by Fastex, Div. of Illinois Tool Works, Des Plaines, Ill.—**End**

TYPE A—*maximum impact strength. Toughest member of the IMPLEX family.*



TYPE B—*high gloss, good impact strength, good moldability in thin sections.*

TYPE C—*maximum resistance to stain and abrasion. Developed especially for piano keys.*



TYPE F—*highest heat distortion temperature, good impact strength. Used in vending machines for valves and canisters.*

IMPLEX

4 types to meet your exact molding needs

IMPLEX® high impact acrylic is more than a tough, stable plastic. It is a *family* of formulations developed especially to meet the requirements of a wide range of injection molded parts. Properties include low water absorption, good electrical characteristics, excellent dimensional stability, and resistance to staining and attack by most chemicals.

IMPLEX contains no plasticizers—the combination of properties in each of the formulations is inherent in the plastic itself. In its natural color, IMPLEX is off-white translucent, and many opaque colors are available. Sheets, rods and tubes can be extruded and easily cut, drilled, cemented and formed to complex shapes.

Whatever your application, there's an IMPLEX formulation to give you the performance you require. Write for detailed information.

Chemicals for Industry

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In Canada: *Rohm & Haas Company of Canada, Ltd., West Hill, Ontario.*

LITERATURE

Write for these publications to the companies listed. Unless otherwise specified, they will be sent gratis to executives who request them on business stationery.

"Classifications of High Polymers: A Review," *by Applied Chemistry Sect., Plastics and High Polymers Div., International Union of Pure and Applied Chemistry.*

Published in 1960 by Butterworth & Co. (Canada) Ltd., 1367 Danforth Ave., Toronto 6, Ont. 54 pages. Price: $2.25.

The booklet gives a critical and objective review of the 27 classification systems for high polymers covering the field of plastics, rubbers, and synthetic fibers. Section 5 contains a comparison of the systems, some of which also include a labeling system. Classifications are based on: 1) chemical structure of the polymer; 2) origin of the polymer or the chemical structure of the monomer(s); 3) properties or quality specifications; 4) requirements of patent documentalists; and 5) alphabetical systems.

"Plastic Foams for Packaging," AMA Management Report No. 43.

Published in 1960 by the American Management Assn. Inc., 1515 Broadway, Times Square, New York 36, N. Y., 100 pages. Price: $3.00; AMA members, $2.00.

There is probably no more timely, concise, or authoritative survey of the status and future of foams in packaging than this publication of 20 papers, presented at an AMA Packaging Div. seminar held in Jan. 1960. The introduction by R. H. Thomas, one of the discussion leaders at the seminar, is an admirable presentation of some basic economic facts which put into perspective the case histories, and other data discussed by the other packaging experts. This volume is full of important information presented in a clear, readable fashion. To quote the summary of this publication, "The various sections of this report constitute what might be termed a concentrated course in foam plastics for packaging"—and it is a course worth taking.—*G. B.*

"Elements of Ion Exchange" *by R. Kunin.*

Published in 1960 by the Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 164 pages. Price: $5.75.

Designed for the non-expert in ion exchange, this book covers the subject in survey fashion and requires only a basic familiarity with chemistry. Included are chapters on the nature and structure of ion exchange resins, their synthesis, how to test them and how they are applied. A good introductory work on this important subject.

Plastic molding machines. Brochure includes sizes, models available, features, etc., for a line of conventional and preplasticizing injection machines; and compression, transfer, reinforced plastics, and melamine presses. Bulletin 6000. 16 pages. *Hydraulic Press Mfg. Co., Mount Gilead, Ohio.*

Polyethylene film. Chemical composition; gas transmission; machinability; printability; colors, thicknesses, and widths available; applications in packaging, construction, agriculture, and industry; etc., for Visqueen polyethylene film. 16 pages. *Visking Co., Plastics Div., 6733 W. 65th St., Chicago 38, Ill.*

Knife cutters. Specifications, features, uses, etc., for a line of rotary knife cutters, which are used for cutting plastic sheets and trimming PE film and other plastic compounds. Bulletin K-460. 8 pages. *The Young Machinery Co. Inc., Robinson Div., Muncy, Pa.*

Bulk Handling Methods suggests rules of thumb to be followed in selecting a materials handling technique best suited for varying plant conditions. Outlines equipment required and estimates investment needed for plants that are using 100,000 and over pounds of bulk commodity per month. 14 pages. *Spencer Chemical Co., Dwight Building, Kansas City 5, Mo.*

Principles and Practices of Modern Winding is a revised handbook dealing with the efficiency and production economy realized with winding installations in plastics, paper, and other industries. Substantial technical data, specifications for machines, uses, etc. 18 pages. *Hobbs Mfg. Co., 26 Salisbury St., Worcester 5, Mass.*

Organic chemicals. Physical and chemical properties, uses, handling and physiological hazards, etc., for dodecenyl-succinic anhydride, which is used as a curing agent for epoxy resins, as an intermediate for plasticizers, etc. Bulletin I-8R. 30 pages. Similar data for hexahydrophthalic anhydride, used in the manufacture of alkyd resins, coatings, adhesives, etc. Bulletin I-2R. 20 pages. "National Organic Chemicals" provides detailed information on the numerous organic chemicals produced by the Division. 22 pages. *Allied Chemical Corp., National Aniline Div., 40 Rector St., New York 6, N. Y.*

Cleaners and stripping agents. Specifications, uses, features, prices, etc., for Meta-Strip 702 Liquid and Meta-Strip 702 Gel, which are synergistic, non-corrosive solvents for removal of cured epoxy, polyester, and similar resin compounds. Bulletin DB-702-560. 2 pages. Similar data for Meta-Terge 1405 Gel, a safety clean-up detergent for uncured epoxy resin compounds, greases, printing inks, etc. 2 pages. *Metachem Resins Corp., 530 Wellington Ave., Cranston, R. I.*

Designing High-Impact Phenolic Molded Parts presents 12 new design rules for minimum cost, based on latest industrial experience with fibrous glass-reinforced phenolic resins. Includes tables covering shrinkage limits for high-impact phenolics, comparison of mechanical properties of phenolic and polyester resins, and minimum wall thickness around inserts. 4 pages. *Durez Plastics Div., Hooker Chemical Corp., 7004 Walck Rd., N. Tonawanda, N. Y.*

Epoxy resins. "Epoxy E-Form Pellets for Electronic Components" discusses the variety of pellet compounds available; epoxy packaging techniques, such as encapsulating, sealing, impregnating, ruggedizing, potting, end sealing, embedding, and bonding; typical applications; and gives case histories showing how various electronic components are packaged with E-Form epoxy pellets. Bulletin 3. 4 pages. *Epoxy Products, 137 Coit St., Irvington, N. J.*

Conversion chart. Lists the specific gravities of thermoplastic materials and metals with conversion figures in ounces and grams per cubic inch. Also includes volume formulas for shapes most commonly used and the properties as well as the advan-

tages of Kralastic ABS resins. *Naugatuck Chemical Div., U. S. Rubber Co., Naugatuck, Conn.*

Polyethylene film. Specifications for all standard PE films, including general films, bread wrap, overwrap, and high impact films; packaging and marketing specifications; schematic drawings illustrating roll put-up, charts, and formulas for calculating yield and standards for a line of polyethylene films. 14 pages. *Chippewa Plastics Co., Div. of Rexall Drug and Chemical Co., Chippewa Falls, Wis.*

Plastic knobs and handles. Specifications, dimension drawings, illustrations, etc., for a line of molded phenolic ball, oval, tapered, push-pull, lid, knurled, pointer, and instrument knobs; tapered handles; thumb screws; terminal nuts; etc. 8 pages. *Dimco-Gray Co., 207 E. Sixth St., Dayton 2, Ohio.*

Antioxidant. Physical properties, solubility, toxicity and handling, uses, etc., for Tenamene 3 (2,6-Di-tert-butyl-p-cresol), which is used in oxidized, low-molecular-weight polyethylene, as an antioxidant for color stabilization; etc. Bulletin I-107. 16 pages. *Eastman Chemical Products Inc., Kingsport, Tenn.*

Web and filament handling equipment. Deals with tension and torque control units for webs and filaments, automatic edgeguide installations, and electric or pneumatic eye controls for casting, extruding, tube reeling, slitting, coating, printing, etc. *Web Controls Corp., 318 Briarcliffe Rd., W. Englewood, N. J.*

Fibrous glass fuel tanks. Corrosion resistance, specifications, capacities, etc., for a line of fibrous glass Diesel fuel tanks. 4 pages. *Apex Reinforced Plastics, Div. of White Sewing Machine Corp., Washington and Elm Sts., Cleveland 13, Ohio.*

Roll deflection chart. Slide rule can be used in determining, under a given load, the deflection of existing rolls made from various materials. Also useful as a design supplement to compute the proper diameter of a roll for a given condition and for a desired maximum deflection, as well as being helpful in establishing proper amounts of crown. *Frank W. Egan & Co., S. Adamsville Rd., Somerville, N. J.*

Urea and melamine molding facilities. "White Gloves" outlines with illustrations a quality-controlled custom molding service **(To page 178)**

for urea and melamine components for such products as organ keyboards, ceiling light louvers and baby food warmers. 12 pages. *Chicago Molded Products Corp., 1020 N. Kolmar Ave., Chicago 51, Ill.*

Tall oil fatty acids. Definition, typical composition, uses, tests and testing methods, and other statistical data on tall oil fatty acids, which are used for coatings, plasticizers, flotation agents, etc. Bulletin 19. 4 pages. *Pulp Chemicals Assn., 60 E. 42nd St., New York 17, N. Y.*

Urethane foams. Describes production facilities, engineering and design services, equipment available, and types of urethane foam products produced. 4 pages. *Isocyanate Products Inc., 900 Wilmington Rd., New Castle, Del.*

Compression molding machine. Specifications, features, platen sizes, etc., for the Series 628 compression molding presses. 4 pages. *Lempco Industrial Inc., 5490 Dunham Rd., Bedford, Ohio.*

Pigments. Physical and chemical properties, particle size distribution, prices, colors, applications, etc., for a line of colors and pigments for use in the plastics and other industries. 40 pages. *C. K. Williams & Co., Easton, Pa.*

Polycarbonate resin. Physical, thermal, and electrical properties; chemical stability; applications; etc., for using Lexan polycarbonate resin in the electrical and electronic industries. Bulletin CDC-375. 2 pages. *General Electric Co., 1 Plastics Ave., Pittsfield, Mass.*

Phenolic molding materials. Physical properties, test data, applications, molding details, etc., for BMM-7001 and 7002 phenolic molding resins, whose maximum preform temperature is about 295° F. Technical Release 40. 8 pages. *Union Carbide Plastics Co., 30 E. 42nd St., New York 17, N. Y.*

RP structural shapes. Electrical, thermal, and mechanical properties; miscellaneous qualities; thicknesses; etc., for a line of Glasrin reinforced plastic structural shapes. 4 pages. *Plastic Age Sales Inc., 14300 Davenport Rd., Mint Canyon, Calif.*

Casting resins. Physical and electrical properties; interesting features, major uses, etc., for a line of 44 casting and impregnating resins and adhesives. Thirty-nine of the resins are epoxy; 3, cross-linked poly-

styrene; 1, PE copolymer; 1, polyester. Wall chart. *Emerson & Cuming Inc., Canton, Mass.*

Self-locking screws. Specifications, features, etc., for a complete line of industrial socket screws, including one group that is made self-locking by the insertion of a nylon pellet into the threaded section. 82 pages. *Standard Pressed Steel Co., Jenkintown, Pa.*

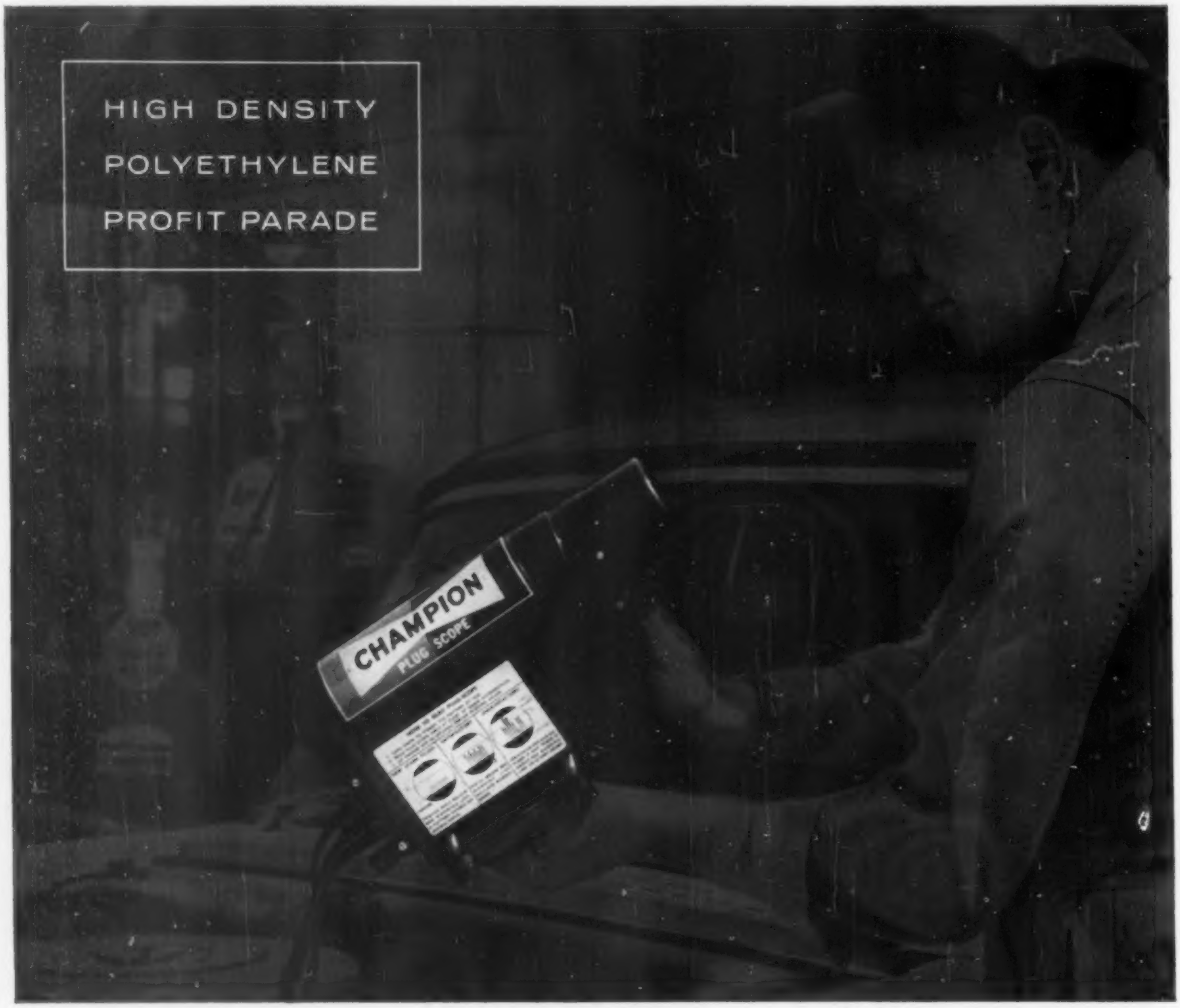
Temperature controller. Specifications, modifications, special features, applications, etc., for the Series 560 indicating electronic temperature controllers, which are used for extruding, injection molding, and plastic packaging. Bulletin MC-185A. 4 pages. *Fenwal Inc., Ashland, Mass.*

Government publications. "Manual on Throw-Away Tooling: Final Technical Engineering Report" outlines the proper approach in setting up an efficient tool conversion program. PB 161276. 96 pages. Price: $2.25. "Fifth Materials Review," another in a series, deals with the polymer and plastics field. PB 161014. 88 pages. Price: $2.25. "Use of Electrical Resistivity in the Study of the Polymerization of Thermosetting Resins." PB 161028. 15 pages. Price: 50¢. "Plastics - Polymer Research (Five-Year Bibliography)" contains selected reports and translations. SB-400. Price: 10¢. "Plastic Drain and Sewer Pipe and Fittings," a printed edition of Commercial Standard CS228-60. Price: 10¢. "Investigation of Multiaxially Stretched Acrylic Plastic." PB 131933. 121 pages. Price: $2.75. *OTS, Department of Commerce, Washington 25, D. C.*

Metallic gold films. Preparations, methods of application, properties, etc., for Hanovia organic gold solutions, which produce metallic gold films that serve as reflectors of infrared radiation. Bulletin 5. 3 pages. *Engelhard Industries Inc., 1111 Wilshire Blvd., Los Angeles 17, Calif.*

Roll leaf stamping equipment. Specifications, typical installations, features, etc., for a line of Kensol roll leaf marking equipment; hand and power presses; light-, medium-, and heavy-duty presses; attachments; etc. 6 pages. *OlsenMark Corp., 124-132 White St., New York 13, N. Y.*

Methyl ethyl ketone peroxide. Wall chart gives the hazards involved in handling MEK peroxide—which is used to cure polyesters—and suggests remedies for casualties. *Reichhold Chemicals Inc., 525 N. Broadway, White Plains, N. Y.*—**End**



Grace Plastic Helps Create New Idea in Spark Plug Testing

An entire set of spark plugs can now be tested at the service station in *less* time than it takes to remove and test *one* plug by methods used only a year ago. This advantage frees the mechanic to provide other services to his customers and at the same time creates a climate for increased sale of spark plugs. This idea is made possible by a lightweight electronic spark plug tester whose housing is molded of Grex high density polyethylene.

Developed and manufactured by Heyer Industries, Inc. for The Champion Spark Plug Company, the Champion Plug-Scope makes it possible for any serviceman to test spark plugs without removing them from the engine. He simply makes the necessary electrical connections and "reads" the condition of the plugs on a cathode ray tube. The Plug-Scope is well suited for use under rugged garage and service station conditions. The housing of Grex is rigid, strong and durable. It is impervious to damage by gasoline, lubricants and other chemicals. Its lustrous black finish is virtually unaffected by sunlight and outdoor exposure.

The new spark plug tester provides economic advantages to both Heyer and Champion. Your new product idea could prove to be equally profitable.

Find out more about high density polyethylene by calling in the experts. Grace has the production, technical, and marketing facilities to help put your product in the Grex profit parade. Everyone says we're easy to do business with.

Grex is the trademark for W. R. Grace & Co.'s Polyolefins.

W.R. GRACE & CO.
POLYMER CHEMICALS DIVISION CLIFTON, NEW JERSEY

Plastics Digest

(From page 58)

rises in production costs by passing the bulk of the work to a positive model or master. Reasons are given for choosing nickel (Rockwell hardness 48) as the internal surface of the mold and copper (Rockwell hardness · 30) for the body of the mold.

Automatic buffing and polishing of lacquered surfaces. W. Burhart. Kunststoffe 50, 257-59 (Apr. 1960). Some automatic buffing and polishing machines and recently introduced accessories are described to give a general picture of the possibilities of automation in this field, with special reference to surfaces that are treated with polyester based lacquers.

Applications

Polythene blocks in nuclear engineering. G. Haim. Plastics (London) *24*, 473 (Dec. 1959). The use of massive blocks of cast polyethylene for radioactive shielding is discussed. Major applications are in uses requiring stringent space and weight limitations, particularly in the marine industry.

New plastics for cars. H. Mark. SAE J. *68*, 26-28 (Apr. 1960). The relations of structure to the properties of plastics with special emphasis on automotive uses are discussed.

Encapsulating with alkyd. J. J. Moylan and J. T. Long. Electronic Ind. *19*, 76-78 (May 1960). The encapsulating of electronic components in alkyd plastics by two molding techniques is described in detail. One uses an alkyd plastic putty and the other one employs a granular molding compound.

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Properties

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Anisotropy in thermoplastic moldings and their impact strength. H. Keskkula and J. W. Norton Jr. J. Appl. Polymer Sci. *2*, 289-96. (Nov.-Dec. 1959). The mechanical anisotropy of several thermoplastic polymers was investigated, and the relationship with a practical dart drop impact measurement was explored. The unnotched Izod impact strength of a specimen taken perpendicular to flow orientation is correlated with the dart drop impact strength. Further, the effect of several dart drop test variables, such as drop height, dart tip radius, and specimen size, were investigated and are reported. The conventional strength measurement of injection-molded specimens may lead to erroneous appraisal of the practical strength of a material. Testing at an orientation normal to flow or by multiaxial stressing as in a dart drop test is suggested.

Publishers' addresses

Adhesives Age: Palmerton Publishing Co. Inc., 101 W. 31st St., New York 1, N. Y.
Chemical and Engineering News: American Chemical Society, 1155 Sixteenth St., N. W., Washington, D. C.
Chemical Week: McGraw-Hill Publishing Co. Inc., 330 W. 42nd St., New York 36, N. Y.
Electronic Industries: Chilton Co., Chestnut and 56th Sts., Philadelphia 39, Pa.
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Journal of Applied Polymer Science: Interscience Publishers Inc., 250 Fifth Ave., New York 1, N. Y.
Kunststoffe: Karl Hanser Verlag, Leonard-Eck-Strasse 7, Munich 27, Germany.
Materials in Design Engineering: Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y.
NBS Technical News: National Bureau of Standards, Washington, D. C.
Plastics (London): Temple Press Ltd., Bowling Greene Lane, London EC1, England.
Plastics Progress in India: Chowpatty Chambers, Sandhurst Bridge, Bombay 7, India.
Plastics Technology: Bill Brothers Publishing Corp., 630 Third Ave., New York 17, N. Y.
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TEFLON GASKETS. 4-page product data sheet describes a line of Teflon Gaskets which include envelope and solid, standard and custom sizes. Also additional folders on Teflon rod, tube and sheets. Chemo Products Inc. (H-041)

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Film laminations

(From pp. 79-84)

include packages and displays, toys, novelties and models, luggage and ornaments, wall panels, tiling, upholstery, automotive and aircraft interior trim, and various appliance components, such as decorative panels for refrigerators, air conditioners, etc., clock faces, and radio and TV grilles. Properties of the finished laminates include dimensional stability; high flex, bond, tensile and tear strength; retention of brilliant finish without tarnishing or growing brittle; and resistance to moisture, chemicals, solvents, flaming, scuffing, abrasion, cracking, peeling, and stretching.

In its new Golden Falcon Electra aircraft, Eastern Airlines required a cabin trim material for wear points such as top and base rails, valances and seat side panels which would combine beauty with rugged practicability. The material specified consisted of metallized Mylar film laminated between two layers of Kodapak II butyrate sheet, made by High Vacuum Metals Inc., New York, N. Y. Also produced by this company under its Chromeflex trademark are various laminations of metallized polyester film to coated sheeting, embossed to simulate different grains. These are used for shoe coverings, belts, handbags, and other items in the apparel area.

From sun tans to refrigerator insulation

An unusual consumer application of plastic film laminations is the Tin-Tan, a portable box-like device which collects the sun's rays to tan its lounging occupant while keeping temperatures bearable even on a cold day through reflected heat. If fabricated of metal, this unit would have been too heavy for portability, as well as difficult and expensive to make. Instead, it employs metallized Mylar, backed by vinyl film, on the sides and floor. Light and easily portable, it can be rolled into a compact bundle. Arvin Industries Inc., Columbus, Ind., also uses a lamination of Mylar film for the printed circuit heating element of a large three-panel radiant-heat type folding screen. Here the di-

electric strength and high melting point of the polyester material satisfactorily meet the rugged service requirements.

For its new flexible counter-top material, Bolta Products Div., General Tire & Rubber Co., selected a pigmented vinyl base laminated to a surface layer of tough, abrasion-resistant Mylar film. Thanks to the transparent polyester layer, which permits the colorful vinyl to show through, Bolta-Top is easy to clean, resists moisture and household chemicals, and will not chip, peel, or fade.

Hotpoint Co., seeking a more efficient type of refrigerator insulation which would be much thinner than conventional types, adopted a lamination of polyester film, kraft paper, and saran film produced by Arvey Corp., Chicago, Ill. Fabricated into bags containing 1½ in. of glass fiber insulation, the material is used to fill the sides, backs and doors of certain Hotpoint refrigerators and freezers. Using this material, Hotpoint can transform a 14-cu.-ft. refrigerator into an 18-cu.-ft. model without increasing exterior cabinet dimensions.

Electrical and instrumentation uses

Hotpoint places two pieces of the laminated material in an electronic sealing machine, sealing it on three sides to form an envelope. After an inspection routine, glass fiber batting is loaded into the envelope and it is placed in a charging chamber. Here air is evacuated from the unit, Refrigerant 12 is charged into the chamber and the end is sealed. Following leak tests, corners of the bag are dipped in a paraffin-type material and they are ready for assembly into the cabinets. Although cost of the new insulation is about 10% higher than the former material, this is more than offset by the increased storage space gained.

Various combinations of polyester film, cellulose acetate, asbestos, kraft paper, and other materials are used in the electrical field for motor insulation, slot cells, wedges, transformer layer, and phase insulation. Through proper selection of the plastic films and other materials used, these laminations may be engineered with

the required degree of flexibility, electrical strength, moisture resistance, and other properties.

Plastic film laminations have also found an important new outlet in photoelectric and mechanical control tapes, which are perforated and used in integrated data processing equipment, in missile guidance systems, as well as to control automated machine tools. Some of these new developments require a perforated control tape which may be re-used several hundred times daily. Because of its high tearing resistance, plus the fact that it is not affected by temperature and humidity changes, polyester film has proved ideal for laminations used in this application.

Since polyester film is transparent in its natural state, it is hard to see punched holes, and also difficult to write upon. The answer was found in a special lamination of Mylar and paper. In its product testing department, Friden Inc., producers of integrated data machines, found that the laminated Mylar tape had a service life of 300 to 400 times that of paper control tape. Aluminum foil-Mylar tape, with its superior strength, is not affected by the starting and stopping tensions of automated contouring machines and similar equipment. This combination yields a very strong, thin tape offering greater yield per roll than can be obtained from practically any other types of tapes.

Air houses, tarps, and research balloons

Polyester, vinyl, polyethylene, and other types of films, laminated with reinforcing strands of Dacron or nylon, are gaining increased use in air houses, greenhouses, high altitude research balloons, and other structures requiring a combination of light weight, wide temperature tolerance, low cost, and exceptional strength. Typical of these materials are fabric-film laminates produced by Griffolyn Co. Inc., Houston, Texas. They are used in bags and sacks, tarpaulins, athletic and swimming pool covers, pit and tank liners, etc., as well as in weather shelters, air-supported buildings, protective clothing, balloons, and tents.

The Griffolyn laminations, which employ several combinations of

plastic films, including white or black PE, Mylar, vinyl and polyvinyl fluoride (Teslar) are light in weight, flexible, tear-resistant, rot-proof, waterproof, and non-corrosive. Their exceptional tear strength is obtained by sandwiching between the plastic plies strands of Dacron which pull together to form a "rope" when a tear is initiated and effectively stop it from spreading beyond the point of initial tear. Use of a soft, permanently tacky adhesive makes this action possible.

High Vacuum Metals Inc. produces a lamination of aluminum foil and polyester film which is now being used in the Navy hutting program, as well as in other types of buildings. Space Structures Inc., Chanhassen, Minn., has developed "permanent bubble" buildings by utilizing reinforced Scotchpak polyester film in combination with a "rigidizing" technique. In this process, air buildings formed of the film laminate are first inflated to shape, then made permanent by spraying them with a compound consisting of various materials—fiber, cement, glass, and even clay. Next, air is released from the structure and doors and windows are cut out. Simultaneous drying and curing of the rigidifying material takes only 20 min., it is claimed. Priced at only about $1.75 per sq. ft., these buildings can be easily constructed in a few hours with a minimum of labor requirements.

These applications give some idea of what is being accomplished with plastic film laminations. What the future holds in this field will be limited only by the imagination of those who work with today's films and the even better films now being created in the nation's plastic research laboratories.—**End**

• • •

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Pressure forming

(From pp. 85-87)

total variation of the diameter of a 5-in. closure is typically 0.005 in., or only 0.1 percent. Commercial users have in general been satisfied with visual inspection only—such is the precision of this particular operation.

Materials and markets

While nearly all plastic sheet materials can be pressure formed, the major stimulus to the rapid growth of pressure forming in the past two or three years has been the fact that the newer materials have been quite difficult to fabricate with the conventional vacuum forming techniques.

The Auto-Vac machine was first designed to form polyester film into shapes that might be used in a variety of industrial packaging applications. The Emhart machines were developed to pressure form highly oriented polystyrene sheet at high rates as well as to precise dimension.

Pressure forming is also used with more easily-formed materials, such as rigid vinyl chloride sheet, where high production rates and exact reproduction are required. In one application, over one million chloride milk bottle caps are produced each day. Cellulose acetate and cellulose acetate butyrate also find their place in pressure forming in both the packaging as well as the display field. And the newer "exotic" laminate sheet combinations will surely be naturals for applying these techniques.

The major initial market where the pressure forming technique filled a need was in the packaging field. Figure 4, p. 87, shows pressure formed portion food packaging, Fig. 5, p. 87, pictures milk bottle caps, and Fig. 6, p. 87, shows food container lids.

Drinking cups, cake boxes, ice cream servers, friction-fit containers and lids, shapes round, square, rectangular and triangular are only a few of the items currently being made.

Next step: The application of the pressure forming concept to make massive industrial applications, for example, automotive parts, refrigeration door liners and shells. This phase is even now receiving accelerated consideration as competitive conditions demand more product innovation and more precision as well as improved performance.

This move to larger parts will involve more finely-engineered tools than have been generally accepted in vacuum forming. But for long runs at fast cycles, with exact part dimensions, it is a development that is bound to come.

Just as vacuum and drape forming, blow molding, sintering, and extrusion casting were the "sleepers" in processing techniques, and are now breaking into wide usage, so pressure forming is the new sleeper of the plastics industry. It has developed the engineering skills, the experience, materials, and equipment needed for production. Pressure forming offers a challenge to all elements of the plastics business to keep abreast of this relentless progress of a process.—**End**

Plastics in lighting

(From pp. 94-97)

redirected through the panel at right angles to the panel face. These panels are designed for indoor fluorescent fixtures only, and they are used primarily in nonresidential applications; however, it has been recently reported that a large residential housing development is featuring them.

Another example of innovation from the never-stand-still lighting industry is the luminous ceiling with built-in acoustical control, manufactured by Contrex Co., Chelsea, Mass. The ceiling material contains a clear core of perforated vinyl sheet that is faced on both sides with a porous cellulose film. Noise reduction up to 70% is claimed for this double-duty ceiling. Corrugated vinyl with a matte finish, commonly found in luminous ceilings, is also featured in the prefabricated hanging ceiling units that are currently marketed by Diffusa-Lite Co., Conshohocken, Pa., which describes them as "islands of light."

An open louvre-diffuser, injection molded of light-stable polystyrene by Edwin F. Guth Co., has the unusual effect of blending into a seemingly solid panel when viewed at an oblique angle. This unique feature is made possible by spear-like tips, integrally molded into the louvre vanes. Still another louvre-diffuser combination, this from Curtis-AllBrite, Chicago, consists of two pieces of vinyl—a flat top sheet and a vacuum formed cellular bottom sheet—which diffuse light through four vinyl thicknesses when observed at normal viewing angles, yet transmit light to the work area through just two thicknesses. A unique circular louvre design and a suspension system utilizing thin wire and clip hangers are features of a light-diffusing, floating grillework ceiling made by Integrated Ceilings & Grillework Inc., Los Angeles (see photos, p. 96). Each individual louvre also provides an acoustical trap for noise, and sprinklers, air diffusers and heating elements may be placed above the ceiling because of the open grille design.

When the Union Carbide Corp. recently opened a new headquarters building in New York, a great deal of interest was centered on its lighting system. It is a slight departure from the idea of the luminous ceiling, in that it consists of a continuous plane of independently-hung, recessed lighting fixtures, each with its own diffuser. The diffusers are thermoformed from a laminate of rigid vinyl chloride sheets with an interlayer of flexible vinyl film containing ultraviolet absorbers.

At the other end of the country, the headquarters building of Crown Zellerbach Corp., San Francisco, features a lobby ceiling in which light is transmitted and diffused by cast acrylic plugs. Here again, imaginative yet sound application of a plastic material—more than 16,000 cylindrical acrylic plugs (which were cast by Cadillac Plastic & Chemical Co.) are suspended through perforations in polished brass pans—has resulted in a striking as well as successful installation design. (See p. 94.)

Plastic forms for lighting

As a rule, plastic materials for lighting are extruded, injection molded, thermoformed, calendered or cast by outside processors, then supplied to fixture manufacturers in the form of flat panels, formed pans, flat or corrugated sheets, rods and tubes, extruded "wraparound" sections, louvre panels in an "eggcrate" pattern, or prismatic lens panels. Although few fixture manufacturers produce their own plastic lighting materials, nearly all control the molds and dies used by the processors.

Polystyrene in particular is a versatile material for processors—it can be injection molded into the "eggcrate" louver panels or the prismatic lens panels, extruded into flat sheets or the "wraparounds," and thermoformed into light-diffusing pans.

Casting and extrusion are the most widely used processing methods with acrylic. According to Cadillac Plastic & Chemical Co., Detroit, a producer and distributor of acrylic materials for lighting, extruded acrylic is gradually supplanting the more expensive cast sheet in lighting applications, particularly in corrugated luminous ceiling diffusers and in thin-gage formed pans. Acrylic prismatic

lenses are either injection molded or extruded.

As noted in Table I, the light transmission of vinyl is somewhat lower than that of the other thermoplastics, so the material is not normally found in thicknesses above 20 mils. Therefore, vinyl is vacuum formed into pans or corrugated in sheet form to provide necessary strength. Also, vinyl is usually calendered, as sheet produced by this method is less apt to become brittle than extruded vinyl sheet.

Plastics in the lighting market

How big is this lighting market now being wooed by plastics? Defining the *entire* goal, the lighting fixture industry today markets approximately 250 million units each year, with a value estimated at $575 million in 1959. Plastics' share of this market lies primarily in non-residential applications, although an exact market breakdown is not available. According to various estimators, anywhere from 30 to 45% of non-residential lighting fixtures incorporate plastics to some degree. One prediction, made five years ago, anticipated plastic lighting fixture usage in 60 to 65% of non-residential structures in 1961.

One reason why plastics have been more successful in non-residential areas has been the wide use of the fluorescent lamp, an elongated light source with a higher luminous output, yet a lower heat output, than the incandescent bulb. It is, therefore, well-suited for the illumination of such large area, non-residential structures as commercial buildings, public and private institutions, manufacturing plants, and similar areas.

And plastics, with their good mechanical strength plus low weight, have become increasingly popular as materials for fluorescent light control. In the home, fluorescent lamp usage rarely extends beyond small kitchen, bathroom, or basement lighting fixtures. The high-heat-output incandescent bulb is still the undisputed king of lighting in the home.

Polystyrene is the most widely used plastic material in the lighting field. From 12 to 13 million lb. of this resin, both in general pur-

pose and impact grades, went into lighting applications in 1959.

The picture for acrylic is not clear, since resin poundage for applications in aircraft windows, outdoor signs, glazing panels, etc., is usually included in "lighting" categories. Industry sources estimate that about 6 to 7 million lb. were consumed in 1959.

Perhaps the fastest growing plastic material for lighting is vinyl chloride, which has gone from about 2 million lb. in 1956 to over 4 million lb. last year.

Urea has a small stake in today's lighting market, probably not much more than 1 million lb., but the material could have quite a future as non-combustible diffuser panels in luminous ceilings. Urea is widely used in the home as incandescent light diffusers, since the stability of the material under the high heat generated by incandescent bulbs ranges from slightly better to almost twice as good as the thermoplastic materials.

Polyester materials, reinforced with glass fibers, provide lightweight, translucent panels for a small part of the lighting market. The RP panels are often poor in resistance to abrasion and ultraviolet light, although proper additives can overcome these shortcomings to a considerable extent.

Cellulose acetate and cellulose acetate butyrate have been used for lighting shields in the past, and butyrate is still found in many small incandescent lighting diffusers, but brittleness and/or lack of dimensional stability have pretty much limited its use.

As for polyethylene, it is used principally as incandescent lamp globes or as lamp shade material in home lighting. However, linear PE is being tested as a possible lighting material and may prove to be a factor in light control applications of the future.

Industry and public acceptance of the applications previously mentioned indicates that considerable potential exists for plastic materials in the lighting field. Upgraded material formulation as well as a fuller understanding by lighting engineers of plastics' design potential have now combined to foreshadow vastly increased poundage for both thermoplastics and thermosets.—**End**

Street________ State________

Switch from steel

(From page 101)

weight was reduced from 40 to 12 lb., which lowered shipping expenses and also made installation much easier. These cost and property factors are expected by Borgerud to lead to expanded markets for this type of unit. The tank and components are molded of glass-reinforced bisphenol-A polyester resin (Atlac 383, Atlas Powder Co.) by Masterglas Div., Gisholt Machine Co. A cover and float shield that guard the automatic recirculation mechanism are also made with Atlac 383.

First step in the production of a tank is the making of preforms. These are made on an open unit rather than on automatic preform machines because of the height (4 ft.) of the tank. A perforated metal preform screen formed to the general shape of the tank is anchored in place and a suction applied inside the preform screen. A combination chopping machine and blower places the glass fibers on the screen where they are held by the internal suction. A polyester binder resin in water emulsion form is applied to the glass preform and cured at about 400° F.

The operator then places the shaped glass upside down over the male die in the press and applies the resin on what will be the bottom of the tank. The press supplies 150 tons of pressure at a molding temperature of 235° F. Curing of the tank is complete in 3 minutes. A jet of air blown through an opening in the male die simplifies removal of the completed tank. Approximately 100 tanks a day can be manufactured by one man.

Tank is difficult part to mold

The tank itself is approximately 4 ft. tall. The walls, which run approximately 0.090 to 0.100 in. finished thickness, have a taper of only 1/12 degrees in the total height of the tank. Molding of this part originally presented considerable difficulty because the female die actually compresses the glass preform as it is lowered over the male die. Closing speeds were extremely critical because too rapid a movement at the final mold closure tended to force the liquid resin through the glass and caused channeling and weak spots in the tank. At slow closing speeds, the combination of temperature and pressure caused the resin to start to gel; the increase in resin viscosity and decrease in its ability to thoroughly wet out the glass brought about additional tearing.

In production, the mold is completely closed in 18 seconds. The first 28 in. of mold travel are completed in 4 sec., while the remaining 16 in. of travel take 14 seconds. The proper combination of closing speeds, temperature, and catalyst provides solid part with a rich protective coating of resin on the inside of the tank without resin-rich or unwet areas in the wall.

The dies were manufactured by the Machine Tool Div. of Gisholt Machine Co., Madison, Wis., from tool steel and subsequently chrome plated. Total cost for the dies to make the tank, tank cover, and float protector was only about $6000, or around one-tenth the cost for dies for steel tanks.—**End**

Winding–Part I

(From pp. 105-110)

as diameter build-up ratio, tension ratio, mode of operation, degree of control accuracy, and degree of power efficiency have been chosen, Table IV may be used to determine what type of drive appears most suitable.

Winders

There are basically two types of winders, surface winders and center winders. In surface winding (Fig. 1, p. 105), material is wound up by the action of driven rolls in contact with the surface of the package being wound. Tension is applied to the wound roll either by the weight and pressure of the wound roll against the driven rolls, or by the speed of the driven rolls relative to the speed of the web. In conjunction with the former method, a hold-down roll is normally used which can be adjusted to vary the pressure on the wound package and drive roll. Surface winding is usually employed with materials which may be wound under relatively high tension and is used with materials which do not ordinarily have much stretch.

In center winding (Fig. 2A to 2E, p. 106), the web is the load that dictates operation of the winding unit. The necessary torque increase or decrease is sensed directly or indirectly from tension in the web. Controlled and constant tension is maintained by sensing the web tension changes automatically as the diameter of the material being wound builds up, and the speed of the drive is automatically and proportionately adjusted, thus maintaining the desired torque-speed characteristic at all times during roll build-up. Two basic types of center winding machines, fixed shaft and turret winders, are employed to meet varied winding requirements.

Fixed shaft winders. Single shaft (Fig. 2A), is the type normally used for roll-to-roll processing. In addition, both two-shaft, horizontal (Fig. 2B) and staggered (Fig. 2C) fixed shaft center winders are used in film processing. The horizontal two-shaft winder is used in certain cases, when it is more convenient to

bring the web path down or up between the two rolls. Both horizontal and staggered models are used for relatively low-speed continuous processes where the web must be cut from the full roll and transferred manually to the empty core on the fly; because of the fixed shafts, the speeds at which this transfer can be handled are somewhat limited, and depend to some extent on the skill of the operator. Fixed shaft center winders are made in staggered models (Fig. 2D), with three individual winding drives for tension control. These winders are used for processes where a single sheet of material is being slit into two webs, and the web speed used is relatively low. The third station permits handling of the two side-by-side webs with ease, winding one web on one station and the second web on another station, the third station permitting the free transfer of either full roll to an empty core. Four-shaft, staggered (Fig. 2E), center winders are also available. These are generally used for process lines where two webs are being produced, one atop the other, or for applications where tubular materials like collapsed layflat film are edge-trimmed on both edges, resulting in two separate webs that must be handled. Essentially a dual form of the two-shaft staggered winder, these machines are generally used for low process speeds only. They are available with either dual or individual drives, according to the operating requirements.

Turret winders. Two-shaft machines (Fig. 3A, p. 107), are used for moderate to high speeds; or for applications where the turret head will make it easier for the operator to cut-over on the fly.

The four-shaft (Fig. 3B) turret winder is comprised of two turret heads combined in a single highly efficient machine. These winders are normally used in higher speed applications where tubular materials are being trimmed on both edges and the resultant two sheets must be handled simultaneously.

• • •

Part 2—dealing with winding accessories and sample calculation, including equipment cost—will be published in a forthcoming issue of Modern Plastics.

Fishing tackle

(From pp. 98-100)

lures (meant to imitate a large bug or minnow floating on the surface) are now made with molded polystyrene foam bodies (see photo, p. 98), replacing the formerly used cork body.

Also becoming very popular as a lure material are insect and small bait imitations molded from vinyl plastisols (made by Burke Flexo-Products Co., Creme Lure Co., DeLong Lures, and others). Limp, rubbery formulations are used to imitate worms, crayfish, minnows, and insects (see photo, p. 100). Vinyl film is also used in some lures to imitate eel skins or, when printed, as veined insect wings in flies.

A recent innovation in fish lures is the Krafty Fish Caller (Birch-Kraft Inc., Milwaukee, Wis.). This unique item consists of a battery operated device which is lowered on a line into the water to the bottom, and emits a buzzing noise which attracts fish to the area in which the angler is fishing. The housing for the mechanism is injection molded of Tenite cellulose acetate butyrate material.

Accessories and packages

Tackle boxes, formerly all made of metal or wood, are now available in high-impact styrene, fibrous glass-reinforced polyesters, and high-density polyethylene. Biggest advantages are corrosion resistance, lighter weight, and reduction of noise.

Minnow buckets and bait boxes now come in injection and blow molded polyethylene and foamed polystyrene. These float and cannot be lost in deep water. Their good thermal insulating qualities help keep the water in the bucket cooler. This reduces oxygen loss from the water and keeps the bait alive longer.

Another accessory made completely of plastic is a fish stringer (Lewis E. Hamel Co. Inc., Rochester, N. Y.) with injection molded nylon hooks or snaps on a nylon cord (see photo, p. 100). Other items are listed in the table, p. 99.

The majority of plug-type lures and many flies now come packed in polystyrene boxes. Also packaged in this type of box are fishing lines of all sorts and the majority of line now sold is wound on spools injection molded from polystyrene. The use of plastics, in addition to providing a novel package, also gives the manufacturer a chance to build economically in re-use value for the angler and thus add to sales appeal. A good example of this is the B. F. Gladding Co. fly line package. The novel injection molded spool on which the line is wound at the factory can be used afterwards for line storage and transfer (see photo, p. 98). Removable plates included with the box in which the line is packed allow the angler to convert the box into a compartmented bait and fly box.

Clearly, plastics have "caught on" in the tackle industry and have revolutionized tackle design and production techniques. Because of their ideal properties, it is fairly certain that their use in fishing tackle will continue to expand.—**End**

Plastic shelters

(From pp. 113-122)

struction field offices, railroad structures, boat houses, bus stop shelters, and phone booths. As techniques are improved, it is not unrealistic to expect larger structures, such as garages, summer cabins, small warehouses, and similar buildings to be built using the spray-up method.

The problem of shipping many crates of prefabricated panels or modules for assembly at the site would be greatly reduced. Structures which are made by the spray-up process avoid the more sophisticated designs encountered in factory pre-fabrication in which assembly techniques become a major area of concern now plaguing pre-fab structures. Current mechanical problems of fastening devices and leakage at joints are completely eliminated due to the spray-shell's monolithic type structure.

Important cost savings can be realized simply by the elimination of huge costly molds. Material, such as fibrous glass roving which is used, is less expensive as compared to cloth and mat forms. Glass and resin waste are reduced to a minimum since practically all the roving is used up and there is minimum loss of resin due to the fact that catalyzed and promoted resin are never mixed until deposited. Production time is reduced greatly through faster production of large items.

Initial expenses incurred through purchase of spray-up kits including the mold would not be too dear; and this cost, when prorated over several structures fabrications, becomes insignificant as compared to the overall expense of tooling for a variety of pre-fab shelters. The purchase of raw materials would probably be the only recurring expense and even this would be at most comparable, if not less, to that incurred in factory fabrication.

Acknowledgment

The authors wish to gratefully acknowledge Robert B. Curtis of RADC's Structural Engineering Section for his cooperation in providing the structural design analysis.—End

DTA

(From pp. 125-130)

duced in polymeric systems by irradiation. Changes were detected by DTA that were not observed by conventional infra-red analysis. Potential also exists for the application of selected polymers as dosimetry detectors over a wide range of energy levels.

Future potential of DTA

There is considerable interest in the application of plastics as structural materials. Accompanying this interest there is concern over the weathering properties of the plastics. Weathering is an over-all kind of action composed of the combination of factors related to the action of ultra-violet light, airborne particulate matter, oxygen, and water. Controlled atmosphere equipment, utilizing water as a gaseous constituent, could lead to the standardization of the DTA method as a means of obtaining accelerated data on this facet of weathering.

The thermal decomposition temperatures observed by DTA are higher than those usually associated with materials from life-testing procedures. For example, polymethyl methacrylate decomposes at 290° C. by DTA(8). No one would consider using this material for extensive periods at temperatures in excess of 100° C. DTA, however, does show that the thermal decomposition of polyvinyl acetate occurs at lower temperatures than polyvinyl chloride (15), which is in accord with ordinary usage. The development of more data of this kind will make the correlation of differential thermal analysis results with thermal life application limits much more feasible.

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Thermosetting resin

(*From pp. 132-138*)

slightly tacky material. Resin contents on the cloth have been adjusted in the usual manner.

The preimpregnated papers and cloth have subsequently been used to make 1/16 to 1/8 in. thick panels in conventional equipment. Cures of 40 to 60 min. at 325° F. have been used in a multiplaten press type of operation.

Applications

The excellent basic electrical properties of Buton A-500 indicate its use in several areas of electrical insulation applications. The basic resin castings have stable electrical properties in varying humidity and temperature environments. This stability has been tested over a wide range of current frequencies. Potential applications include potting, encapsulating and coil impregnation.

Both paper and glass reinforced panels have been fabricated. These panels should have considerable use in printed circuits, timing gears, inserts, and electrical supports. Molding compounds have been formulated to give a wide range of physical and electrical properties. While these are still in the devlopment stage, basic recommendations for outlets, housings, and boxes are available.

Where special electrical properties are required, combinations of Buton A-500 and polyethylene have been used. The resin will bond directly to the polyolefin and form a unit structure. Cover sheets of the polyolefin have been used on both the paper and glass laminates. Also, sandwich laminates have been made with glass cloth surfaced and polyethylene-Buton A-500 sandwich. These have the excellent electricals of the composite with stiffness imparted by the glass cloth faces.

In summary, Buton A-500 should find considerable outlet as electrical insulation. The basic properties are outstanding, and development work has indicated that typical materials can be fabricated in conventional equipment. A versatile range of properties is available through the use of the resin in combination with polyolefins.—End

THE PLASTISCOPE*

News and interpretations of the news

By R. L. Van Boskirk

Section 2 *(Section 1 starts on p. 41)*

August 1960

Significance of the nylon price decline

A nylon price decline of from $1.18/lb. to $1.04 with an "incentive" price for large volume orders set at 98¢ created a stir in some parts of the industry as a possible harbinger of better volume for general purpose nylon molding and extrusion material. Some market analysts estimate that the present market is between 25 and 30 million pounds.

A spokesman for Foster Grant Co. Inc., who set an "incentive" price at 98¢ after Allied Chemical had first announced a reduction to $1.11, further stated that nylon will ultimately become a popular-priced plastic, which to the trade means that it would eventually compete with the lower priced thermoplastics. This eventuality is probably many years away.

The price of nylon today in Canada and European countries is in the 90¢-range.

Opponents of the incentive system immediately lowered their prices to the lowest quotation, which was 98¢. Thus, 98¢ is now the standard price delivered in cans in truckload quantities.

The original Foster Grant price schedule lists all grades of its natural color nylon except one, at $1.04 for 20,000-lb. lots to $1.21 for lots of less than 100 pounds. The extrusion grade designed for film, sheet, tubing, etc., where market development and process technology are not so far advanced, ranges from $1.21 to $1.38.

The so-called "incentive" price consisted of a 3¢ reduction from the $1.04 price for 20,000-lb. quantities when shipped in multi-wall bags of 50-lb. capacity; 80,000 lb. when shipped in hermetically sealed metal cans of 25-lb. to be shipped during a period of six months or less; a 6¢ reduction when shipped in 50-lb. multi-wall bags when ordered in quantities of 80,000 lb. to be shipped over a 6-month period.

Dr. Robert L. Purvin, vice-president of Foster Grant, says that the reason for his company's price reduction was due to improved polymerization processes; better methods of handling and shipping; a growing awareness of the particular properties of nylon-6 and recognition of its color capabilities; and a decreasing cost in production of the monomer, caprolactam, from which nylon-6 is produced. Monomer cost has been reduced 20% since 1957, and even lower prices are expected. This, of course, is a different type monomer than that from which nylon-6/6, made by Du Pont, is produced; although the latter company has always had a caprolactam-type polymer listed as one of its formulations.

Dr. Purvin stated that the new price should increase the use of his company's nylon in housewares, housings for electrical appliances, radio cabinets, air conditioner grilles, lighting fixtures, building hardware, as well as in the presently established markets in bushings, gears, cams, and mechanized parts. His own company's nylon combs and sunglass frames are examples of how nylon can be used in the consumer market Dr. Purvin is pushing.

Comment in the trade on the nylon price situation is varied and conflicting. Large volume molders have a different axe to grind than small volume processors. There are said to be today only 8 or 10 customers who would use enough material to take advantage of an "incentive" price and increased volume will not necessarily raise their profit since they have reached a size where more business means that they will probably have to increase the overhead costs such as more salesmen, factory employees, research and development, etc. The difference in price between 5000 and 20,000 lb. is still only 2¢/lb., unless the molder could have taken advantage of the "incentive" price which made a possible reduction of from 3 to 6¢ a pound. Furthermore, there are certain molders who make more profit by molding a smaller quantity of higher priced resin than by molding a larger volume of lower-priced resin. But the lower price may appeal to lower volume nylon molders who want to increase their sales and believe that the new price will help them find a number of new markets.

Like most other incentive price programs, this one resulted in the incentive price becoming the base price; but it did bring about a 20¢-per-lb. reduction for nylon. No one knows how long it will take for the trade to cash in on that reduction in order to obtain a profitable increase in volume.

Another interesting angle in the Foster Grant announcement was the statement that 50 lb. multiwall shipping bags would be used for the 80,000-lb. orders to gain the 6¢ price reduction. In recent years nylon has been shipped mostly in 25-lb., hermetically sealed cans to prevent moisture absorption and eliminate a drying operation before molding.

Nylon seems to be in a different position from any other plastic in the industry and trying to forecast its future is hazardous. There will probably be more business done at a 98¢ price, but will there be enough to create big volume? Up to now most nylon applications have been mechanical or engineering type. In a mechanical plastic the service costs are 2 to 10 times higher than in a consumer plastic because of the time and research involv- **(To page 204)**

* Reg. U. S. Pat. Off.

(From page 202)

ed in developing a new product. Large pieces are still difficult to mold, although some progress is being made. In competition with metals it is still somewhat more costly (see comparison table, below), except for brass. And in this brass field, nylon has moved slowly, although it has cost less for a number of years. And even if nylon should get into the 40 to 50¢/lb. range, it would then face severe competition from polypropylene and high-density polyethylene, which would be less costly but still usable for many applications sought by nylon. All the above are, of course, negative factors, but they are factors that would have to be overcome in a growth pattern for use of nylon in mechanical products. On the other hand, if nylon can get a foothold on consumer products such as those mentioned above it could possibly get up into the 60-million-lb.-volume market within a reasonable time; and the purpose of the "incentive" price was undoubtedly to speed up the arrival of that day.

Further development of extrusion grades for film, sheet, and shapes should also help this growth but at present this resin still carries a premium price.

New styrene formulations

Four new formulations of its Dylene polystyrene have been made commercially available by the Plastic Div. of Koppers Co. Inc. The formulations are Dylene 9, an improved heat-resistant material; Dylene 20, a modified medium impact material; Dylene 28, a modified medium impact, heat-resistant material; and Dylene 400, with increased toughness and improved heat distortion; 9 is used primarily for molding of radio cabinets, while 20 and 28 are used for closures.

New fluorocarbon film

A new fluorohalocarbon film featuring transparency and virtually zero moisture absorption has been announced by Allied Chemical. The new film is called Aclar. The film is expected to bring significant economies to the military in the packaging of electronic and other delicate mechanical equipment components, as well as to packaging in general.

Frank J. French, president of Allied's General Chemical Div., reported that to get the moisture barrier benefits of Aclar a saran film would have to be over 100 times as thick, a polyethylene film over 400 times as thick, and a polyester film over 700 times as thick. Mr. French pointed out that this extremely low moisture vapor transmission plus transparency and good impact strength permits Aclar to meet the stringent requirements for Type I film in military specificaiton MIL-F-22191 covering "Films, Transparent, Flexible, Heat Sealable for Packaging Applications."

Other distinctive qualities of the new fluorohalocarbon films are retention of flexibility and other properties over a 700 degree temperature range from −320° F. to 390° F.; resistance to almost all inorganic chemicals including the most corrosive acids and alkalies. Aclar is available in substantial pilot plant quantities. The company has a plant (To page 206)

Comparison of plastics material costs with metal

Material	Sp. Gr.	lb./cu. in.	Cost ¢/lb.	Cost ¢/cu. in.
Alathon polyethylene	0.914–0.96	0.0330–0.0346	32.5–38	1.07–1.31
Delrin acetal	1.425	0.0514	80	4.11
Lucite acrylic	1.19	0.0426	55	2.34
Zytel nylon 101	1.14	0.0412	98	4.04
Zytel nylon 42 extrusion grade	1.14	0.0412	108	4.45
Zytel nylon 31 (low moisture absorption)	1.09	0.0393	126	4.95
Teflon TFE	2.14	0.077	360	27.79
Teflon 100 FEP	2.15	0.078	1160	90.00
Polystyrene general purpose	1.06	0.0383	21.5	0.82
Polystyrene high impact	1.05	0.0379	28.5	1.08
Polypropylene	0.90	0.0325	42	1.36
Modified acrylic	1.12	0.0404	46.5	1.88
ABS	1.02–1.07	0.0368–0.0386	47–49	1.80–1.81
Polyvinyl chloride rigid	1.33–1.39	0.048 –0.050	40–50	2.00–2.40
Acetate	1.27	0.0458	44	2.02
Butyrate	1.19	0.0430	62	2.67
Cellulose propionate	1.21	0.0436	62	2.71
Ethyl cellulose	1.10	0.0397	72	2.86
Polycarbonate	1.20	0.0433	240	9.59
Chlorinated polyether	1.4	0.0505	250	12.62
Magnesium AZ-91B	1.81	0.0653	30.78	2.01
Aluminum SAE-309	2.64	0.0953	25.50	2.43
Aluminum SAE-306	2.72	0.0982	25.00	2.46
Zinc SAE-903	6.6	0.238	16.25	3.87
Brass—yellow	8.5	0.307	23.25	7.14
Brass—85/5/5/5	8.75	0.316	28.50	9.01
Steel—CR alloy (strip & bar)	7.85	0.283	9–15	2.55–4.24
Steel—Tool Standard 0.95C	7.82	0.282	33	9.31
Steel—stainless 304	7.92	0.286	55	15.73

The material costs shown above were compiled by a plastics material producer and are believed representative of the pricing on June 10, 1960. However, no guarantee as to accuracy can be given. For exact quotations, prices should be obtained from the suppliers of the various materials.

INTRODUCING NUOSTABE 983

A new development in vinyl stabilizers for plastisols and organosols

Nuodex has taken the lead in offering a stabilizer combining superior performance with excellent economy for plastisols and organosols in many applications.

Nuostabe 983 can be used for the spread coating of fabric and paper . . . for laminating film to fabric and film to paper . . . for dipping compounds in treating gloves, wire, etc. . . . for stabilizing organosols for the clear top coat of printed floor coverings.

Completely free from sulfide-staining, Nuostabe 983 remains stable far longer under temperatures normally required in laminating. And in certain applications, Nuostabe 983 can be used effectively even without epoxy plasticizers.

With Nuostabe 983, Nuodex has introduced a new metal organic stabilizer to converters and laminators. And, as with all other Nuodex products, Nuostabe 983 is QUALITY CERTIFIED to assure consistent quality and purity of product.

For samples and complete technical data on Nuostabe 983 write

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Fungicides • Nickel Salts • Organic Peroxides • Paint Additives • Stearates • Vinyl Additives

THE PLASTISCOPE

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under construction at its Baton Rouge, La. works that is scheduled for commercial production early next year.

New price for AC polyethylene

A reduction in the price of AC polyethylene, emulsifiable grade 629, and plans to begin immediate construction of a new plant to manufacture various grades of low-molecular weight PE at Orange, Texas, have been announced by Allied Chemical Corp. The new price is 35¢/lb. in truckload quantities. Annual output of low-molecular weight AC polyethylenes—presently all from Tonawanda, N. Y.—will be increased by about 50% at the new facilities at Orange. Principal uses for low-molecular weight polyethylenes are in textile finishes, floor polishes, coatings for food cartons and milk containers, and as an additive for conventional polyethylene and other thermoplastic materials.

AviSun's Canadian distributor

Courtaulds Plastics Canada Ltd., a wholly-owned subsidiary of Courtaulds (Canada) Ltd., has been appointed distributor in Canada of AviSun polypropylene polymer, film, and fiber. AviSun is already producing polypropylene polymer and film on a commercial basis, and expects to have fiber available sometime during 1960. Polymer is currently being produced at 20 million lb./yr. facilities at Port Reading, N. J. AviSun's polypropylene film, trademarked Olefane, is being made at a 10 million lb./yr. plant at New Castle, Del. Earlier this year AviSun announced plans for a 100 million lb./yr. polypropylene plant which is to be built on a site not yet selected.

Reorganization at Celanese

Celanese Corp. has announced a reorganization of certain divisional operations, along with the appointments of John W. Brooks and Richard W. KixMiller as new executive vice presidents and of four new division presidents. Mr. Brooks was formerly in charge of the fibers division and Mr. KixMiller in charge of the chemical and plastics divisions.

Under the reorganization, the number of operating divisions is increased from three to four and various functions are realigned among them. To the existing Celanese Fibers Co. and Celanese Chemical Co. are added Celanese Plastic Products Co. and Celanese Polymer Co. The latter two new divisions supersede the former plastics division. Mr. Brooks has been assigned directional responsibility over the Fibers and Plastic Products companies, and Mr. KixMiller over the Chemical and Polymer companies.

Newly appointed operating heads of the four divisions are: Peter H. Conze, president of Celanese Fibers Co.; William P. Orr, president of Celanese Polymer Co.; David Taylor, president of Celanese Plastic Products Co.; and James H. Worth, president of Celanese Chemical Co.

W. P. Orr

David Taylor

The Chemical company makes and markets a variety of chemical products, and the Polymer company produces and markets basic polymers and plastics molding compounds including cellulose acetate, propionate, polyethylene, and polyester resins.

The Fibers company is responsible for manufacturing and marketing all Celanese chemical fibers and for marketing Fortrel, the polyester fiber made by an affiliated Celanese company. The Plastic Products company makes and markets plastic film, sheeting, and blow molded products.

Other new appointments in the Polymer company include James Flynn as vice president and director of marketing; Dr. Russell N. Clark as vice president and technical director; James E. Wall as manager of manufacturing; and John F. Howe as planning director. Celanese Chemical Co. appointed Robert L. Mitchell to the newly established position of vice president—planning.

New film grade resin

Polyethylene producers are coming into production with new film grade resin faster than a hen can lay eggs. Significant reasons for this trend are constantly improving polymerization technique and vigorous competition for the film grade market where consumption has been leveling off for several months.

There has been a noticeable change in the density of resins used for film. Not long ago nearly all film grade resin was around 0.918. This density has gradually gone up to 0.927 and over in a great many instances. The purpose was to obtain a stiffer film and improved clarity. This is particularly true of resin sold for casting. The latest announcement came from U. S. I. and introduced a 0.933 density resin specially designed for cast film and listed as an improved version of an earlier casting resin that was around 0.929 density. U. S. I. was among the first to enthusiastically promote the use of cast film and is still plugging for its adoption as a major means for increased use of PE as a wrapping material.

Film made from the new resin, designated Petrothene 218, is said to be particularly well suited for overwrapping a wide array of products — soft goods, bakery goods, paper products, meats, hardware, candy, and a variety of foodstuffs. Its haze is said to be very low, and its high stiffness makes easy handling on overwrap equipment possible. Petrothene 218 resin has a melt index of 3.0. It permits haul-off rates of up to 200 ft./min. and film gages as thin as 0.5 mil. Heat-sealing and treating for printing of films made of this resin were found to be easily accomplished.

Plastics engineers from Lowell

Six men received bachelor of science degrees in plastics engineering at Lowell Technological Institute, this year, **(To page 208)**

DOW Plastiatrics

DOW'S CLINICAL APPROACH TO HEALTHY PLASTICS APPLICATION

ACCURATE STRAIN GAGE ANALYSIS OF PLASTICS REQUIRES VISCOELASTIC DATA

Strain gages are becoming increasingly important analytical tools for plastics engineers and designers. However, in using them to evaluate the behavior of plastics under conditions of stress and strain, designers have found that accurate interpretation of strain gage readings is possible only if the readings are related to other factors—notably, time, temperature and environment.

Because standard strain gages (both bonded wire and metal foil types) detect strain by changing electrical conductivity when bent or distorted in any manner, careful mounting on the test part is essential to accurate readings. Once secured to the surface of the test part, however, a gage will measure any strain imposed on the part, directly in micro-inches per inch of strain.

Plastics materials are viscoelastic and their moduli of elasticity are generally quite low compared with wood, metals, ceramics, etc. Because of this, strength characteristics are largely dependent on time, temperature, and the environmental conditions. Since variations in these three factors will affect strain gage readings, the relationships between the factors *must be known* for accurate interpretation. To assist designers, Dow Plastics Technical Service Engineers have developed much data on Dow plastics. An example of their use in stress analysis follows, taking data from Fig. 1.

A hypothetical part for a creep application will be made from Tyril® 767; an application which will subject the part to a constant load (P), producing an initial strain (ϵ_1) on the part. The imposed strain can be measured with a strain gage, then stress calculated using:

$$S_1 = \epsilon_1 E_1$$

where: S_1 = Initial stress, psi

ϵ_1 = Initial strain in micro-inches/inch (from the strain gage)

E_1 = Apparent modulus, psi, at 0.1 hr. (Fig. 2)

If $\epsilon_1 = 2800$ micro-inches/inch $= 2800 \times 10^{-6}$

$E_1 = 5.35 \times 10^5$

Then $S_1 = \epsilon_1 E_1 = 2800 \times 10^{-6}$ in./in. $\times 5.35 \times 10^{-6} = 1500$ psi.

The amount of creep for any given time can then be determined using:

$$\epsilon_C = \epsilon_2 - \epsilon_1$$

where: ϵ_1 = Initial strain reading

ϵ_2 = Strain reading at time "t"

ϵ_C = Amount of creep

Let $\epsilon_1 = 2800$ micro-inches/inch

$\epsilon_2 = 3200$ micro-inches/inch

Then $\epsilon_C = (3200\text{-}2800)$ micro-inches/inch $= 400 \times 10^{-6} =$ 0.0004 inch/inch, the creep occurring at time "t".

One application of a strain gage to a plastics design problem is shown in Fig. 2. A freezer flip lid was studied to determine cause of breakage, the magnitude of stresses at failure, and at what period in the life of the part stresses were being imposed. Strain gages were bonded to critical areas of the flip lid, and measurements made of strain developed during assembly and actual service on the freezer. It was found that failure cracks (see Fig. 2) occurred because the mechanical and thermal applied stresses exceeded the design strength of the material. Further, the gages revealed that the stresses originated during both assembly and in service. The primary source of stress was discovered to be a rigid bond between metal and expanded plastic insulation. This prevented the plastic frame from acting independently, restricting its movement instead. The solution to the problem was self-evident, once the strain gages revealed the mode of stress development.

A few other applications of strain gages to plastics design and engineering problems are: measurement of coefficient of thermal expansion; measurement of Poisson's Ratio; elongation in test specimens; and stress analysis of bottle closures, home water filters, refrigerator parts, automotive parts, etc.

This study of strain gage applications is one of the continuing series of studies undertaken to assist plastics designers and engineers in the most effective selection and use of plastics materials. For information, and for data on Dow plastics materials, write THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Department 1802CS8.

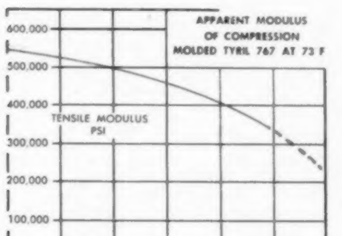

Fig. 1. Long-term data on Apparent Modulus of Tyril 767, for use in strain gage analysis.

Fig. 2. Strain gage analysis of freezer lid reveals source of stress which caused failure.

AMERICA'S FIRST FAMILY OF THERMOPLASTICS

Styron®	Polyethylene
Zerlon®	PVC Resins
Ethocel®	Pelaspan®
Tyril®	Saran

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

(From page 206)

among a class of 132 B. S. and 11 M. S. graduates. This is the third group of plastics engineers who were graduated at Lowell. Freshmen matriculating in September 1954, were members of the first class which produced six graduates in 1958. In June of last year, 18 were graduated with majors in Plastics engineering. Of this total of 30 graduates, 25 went immediately into industry, and the remaining five are currently serving in the armed forces.

According to Prof. James W. Bell, placement director, industrial interest in placement of the plastics graduates has been exceptional and is growing yearly. A number of companies seeking interview appointments could not be accommodated this year, owing to a shortage of students majoring in plastics. With the coming semester, the name of the course will be changed to Plastics Technology, and in the fall the plastics department will be housed in the new $2,108,000 plastics and electronics building on campus.

Latent catalyst for rigid foam

A catalyst system for urethane foams, based on a combination of a molecular sieve with an organo-tin compound, has been developed by Linde Co., Div. of Union Carbide Corp., Tonawanda, N. Y. Called chemical-loaded molecular sieve CW-4107, it is said to be suitable for formulations of the one-shot and semi-prepolymer types for both water-blown and fluorocarbon-blown foams, and costs $3.00/lb. This system delays the initiation of the foaming reaction catalyzed by the organo-tin compounds to provide sufficient time for adequate mixing and to perform other necessary handling operations. The use of rigid urethane foams for foamed-in-place applications has emphasized the need for delayed action catalyst systems, according to Linde.

The company's molecular sieves are synthetic crystalline metal alumino-silicates honeycombed with regularly spaced cavities interlaced by channels of molecular dimensions. Adsorbed molecules can be released from the molecular sieve by the application of heat or by displacement with another adsorbed material. For urethane foams, the catalyst remains isolated during the induction period and is released by the displacing action of polar compounds in the formulation, and heat evolved by the exothermic reaction.

New breathable PVC sheeting

Harte & Co., New York, N. Y., has developed a new breathable leather-grain vinyl upholstery fabric that will be marketed as Breathable Watahyde. In addition to increasing comfort, the breathable vinyl, by allowing passage of air helps eliminate the wear and tear problem to which welted seams on standard sheeting have been subjected. The porosity is produced by a mechanical perforation. It is claimed that the holes will not fill up but rather widen in use because of tension.

Penton lining material

United States Gasket Co., Plastics Div. of Garlock Inc., Camden, N.J., has announced that the company is now marketing Penton sheet stock specifically for vessel lining application. The company is currently supplying the thermoplastic material in extruded form 0.040 in. thick by 21 in. wide. U. S. Gasket also supplies welding seam strip and welding rod. Penton is welded similar to PVC, and is seamed with a heat gun.

Daylight fluorescent pigments in olefins

Processors are reporting successful use of Switzer Brothers' daylight fluorescent pigments in polyolefin moldings. The pigments are available in seven different colors. Because of their glow in daylight, they are particularly useful in toys, traffic markers, safety gear, and merchandising when eye appeal is a factor. Fluorescent pigments developed since World War II have been found by the plastic industry to be practical for polyvinyl chloride resins (plastisols in particular) and molded polyethylene. They are currently being investigated for use in cellophane and polyethylene film. The pigment is an organic, glass-like resin into which fluorescent dyes are introduced while the glass is in a molten state. When cooled, this mass becomes so brittle that it is easily reduced by grinding to a powder made up of dense impervious particles of any desired size range.

The pigments owe their color and brightness in daylight to the fact that they not only reflect light of a particular hue, but can also convert and emit the absorbed portion of the shorter wavelengths of light as more light of the same hue as that which was reflected. The pigments used in polyethylene have only about one-tenth to one-fifth of the color stability which can be obtained with vinyls and should be used primarily in objects intended for indoor use. As little as 2 to 4% pigment content will suffice to give good color to articles that are 40 mils thick or over. Because of their transparent nature, the fluorescent pigments should not be used with opaque, non-fluorescent pigments or fillers which would obscure their brilliance.

The Switzer pigments, available in two series, the A and D, have been used in vinyl plastisols, organosols, calendered film, and molded articles for some time. Three mil thick films require 15 to 30% pigment in order to obtain close to the maximum effectiveness; 40 mil or more thick sections require only 2 to 4 percent. Lower percentages can be used when the maximum brightness is not an important factor.

Interesting colors of intermediate brightness can be obtained by the use of very small amounts of transparent non-fluorescent colors or pigments in conjunction with the fluorescents. Brilliant greens can be made in this way by using a transparent ordinary green with the Switzer Saturn Yellow pigment.

The D series is more stable to outdoor sunlight. Otherwise the colors and other properties of the two series correspond. However, the use of the D series pigment with polyethylene **(To page 210)**

Monsanto Polyethylene Big Batch Uniformity

cuts film extrusion scrap 50%

Deerfield Plastic Company, Inc., Deerfield, Mass. reporting: "The unique consistency and uniformity of Monsanto Polyethylene resin has reduced extrusion scrap by 50%.

"We have reduced frequent breaks or blows, fish-eyes or jells. There are far fewer work stoppages for rethreading and machine adjustments. What's more, our uniformly high quality film means consistent converting conditions for our customers—fewer machine jam-ups, fewer rejects. Result: finer film for bags and overwraps."

Bag-to-bag, blend-to-blend uniformity characterizes the entire Monsanto line of polyethylene resins. No matter how you use polyethylene—for film extrusion, coating, or molding—you're assured of consistent processing conditions. Write to Monsanto Chemical Company, Plastics Division, Room 777, Springfield 2, Mass.

Monsanto

MONSANTO INITIATOR IN **PLASTICS**

(From page 208)

does not usually result in enough improvement over the A series to justify the added cost.

Aerosol overcaps

Sunbeam Plastics Corp., Evansville, Ind., is now serving custom-packers and pressure can users with aerosol overcaps made from high-impact polystyrene and polypropylene. Special features of the company's overcaps include Tripl-Lok flat stacking tops with three gripper lugs reaching over crimped can neck, three tapered flats for snug fit, and three areas between flats which are said to provide friction grip. The caps have a uniform wall thickness and external gating to provide a smooth inner surface.

Builder seeks new materials

Tishman Realty & Construction Co. Inc., one of the country's largest builders, has formed a wholly-owned subsidiary, Tishman Research Corp., to conduct and sponsor research and development in building materials, construction, and allied fields. The new subsidiary is concerned mainly with the commercialization of new ideas in the building field, rather than merely the evaluation of materials. If necessary, Tishman Research Corp. will offer financial assistance to projects that can provide an economic advantage to the company, or that can be sub-licensed or otherwise marketed. Tishman Research's services are also available on a grant or co-operative program basis. New types of modular interlocking panels and more economical ceiling tiles are typical plastics uses in which the research corporation would be interested.

The parent company should prove an important testing ground and volume outlet for new materials, because Tishman Realty & Construction Co. specializes in building and managing large commercial and residential structures rather than one-family residential dwellings. These buildings are a valuable showcase for new materials, since they often house corporate headquarters of leading companies, and some—like 666 Fifth Avenue, New York, N. Y.—have become tourist attractions.

John L. Tishman, president of Tishman Research, has named Joseph H. Newman general manager of the new corporation, which has headquarters at 666 Fifth Avenue. Mr. Newman was formerly an assistant manager in the materials department of Curtiss-Wright Corp.'s Wright Aeronautical Div., and was previously associated with The M. W. Kellogg Co., and The Flintkote Co.

Polycarbonate price reduction

Commercial scale production of polycarbonate resins has been announced by Mobay Chemical Co., in their plant at New Martinsville, W. Va. This resin, named Merlon, has been imported from Farbenfabriken-Bayer AG of Germany, which with Monsanto, jointly owns Mobay, and which developed much of the original technology of polycarbonate processing. Mobay has supplied its customers with imported resin since last fall until the new plant could be completed.

The company also announced a price reduction to \$1.50/lb. in 10,000 lb. quantities, and to \$1.75/lb. for minimum increments. The previous price was \$2.35/lb. minimum from both foreign and domestic pilot plant sources.

General Electric Co.'s polycarbonate plant at Mt. Vernon, Ind. is scheduled to start production in the third quarter of this year and that company too has reduced prices to meet the Mobay level.

Single-component epoxy powders

Two semi-flexible epoxy powders meeting high heat resistance requirements for continuous operation in the H temperature class have been added to the E series of insulating resins supplied by the Marblette Corp., Long Island City, N. Y. Maraset #135E, an unfilled powder, and Maraset #136E, a filled powder, were developed for impregnating and encapsulating electrical and electronic equipment including transformers, coil windings, and other parts. Both are single-component resins requiring no catalyst. Oven cure of 12 hours at 125° C. results in a smooth, uniform, tough, semi-flexible coating which withstands severe mechanical and thermal shock and has good resistance to moisture and chemicals according to Marblette.

Both compositions meet federal transformer specifications as defined in MIL-T-27A. They are low-exotherm materials which are liquefied to 110° C. prior to being applied by dipping or pouring. They have 4-hr. pot life, negligible shrinkage, and a 60% elongation rate, according to the company. Resin #135E has tensile strength of 9000 p.s.i.; resin #136E, 10,000 p.s.i. Working samples of either resin are available at \$4 a quart.

Plastics courses

Evening courses on Process Properties of Plastics; Extrusion of Plastics; Plastic Product Design, and Auxiliary Tooling for Plastics are again offered this fall by the Special Courses Div., Newark College of Engineering, Newark, N. J., in cooperation with the Society of Plastics Engineers. Registration is from August 29 through September 1. The courses begin September 14, 1960.

Vinyl-clad steel for railroads

Thirty-six new commuter passenger cars for Chicago commuters on the Northwestern Railroad have been finished in vinyl coated steel, according to U. S. Steel Corp. The railroad has invested \$27 million in the new equipment and has ordered 116 more cars. Pullman-Standard, builder of the cars, has placed an order with U. S. Steel for 248 tons of vinyl sheets. The steel company says this is cheaper than anodized aluminum, wood, and solid plastics.

PE foam named

The flexible, low-density polyethylene foam marketed by The Dow Chemical Co. since early 1959 without a trade name has now been christened Ethafoam. Early markets have been in marine buoyancy **(To page 212)**

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KLM Royal Dutch Airlines, 609 Fifth Avenue, New York 17, New York.

THE WORLD'S FIRST AIRLINE

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applications. New applications are developing in automotive gasketing, package cushioning, construction, and thermal insulation, according to Dow. The material is closed-cell, has good shock absorbing ability, low water absorption and vapor transmission, and can be fabricated with bandsaws, hot wires and other conventional methods, the company states.

Bacteriostat

Mildew, bacteria, and fungi are said to be lastingly retarded and prevented from growing on plastics products if treated with Steri-tized, an additive developed by Griffin Chemical Corp., Peekskill, N. Y. According to the company, the additive can be incorporated into the full range of plastics materials in either powder or liquid form and does not affect the color, strength, or other properties of the finished plastics product. The company claims that the finished, treated article is rendered lastingly bacteriostatic or self-sterilizing. The additive is introduced prior to molding or forming and is packaged to meet specific production batches. Costs of rendering the plastics material bacteriostatic range from \$0.0025 to \$0.02 per lb. of finished plastics material, depending on formula and volume, the company states.

A continuing laboratory check on the bacteriostatic efficacy of Steri-tized products is offered as a free service to users. Some suggested applications include the prevention of slime on shower curtains and vinyl hose; treatment of toilet seats; coated fabrics; vinyl shoes; floor tiles; and toys.

More vinyl acetate

Reichhold Chemicals, White Plains, N. Y., plans to manufacture vinyl acetate monomer under a license agreement with Wacker Chemie G.m.b.H. of Munich, Germany. The chemical will be produced at a new plant which will have an initial capacity of 50 million lb. with planned expansion to 100 million lb. annually. Location of the new plant in the United States, to be announced later, will depend upon negotiations presently under way with several acetylene suppliers.

Vinyl engraving material

A new vinyl engraving material said to permit higher press speeds, longer plate life and better ink coverage with less ink, has been announced by B. F. Goodrich Industrial Products Co., a div. of The B. F. Goodrich Co. Described by the company as "the most important development in 30 years in the field of engraving materials," the new product, Koroseal 60, is designed for printing bags of all types, including multi-wall, fabric, and burlap. It permits press speeds up to 30% faster than those possible with conventional flexible plates, according to James C. Richards, vice-president of BFG's Industrial Products Co., who stated that the new engraving material does not distort under printing pressures as does rubber. Plate life is claimed to be some 50% longer on the average than other flexible materials.

Licenses for microfibers

American Viscose Corp., Philadelphia, Pa., will offer licenses to make organic microfibers by a new process developed for Avisco by Arthur D. Little Inc., Cambridge, Mass. In the new process, organic plastics such as vinyl, acrylic, nylon, and polyester resins, as well as amorphous materials such as asphalt are melted or dissolved in volatile solvent and then sprayed into an air stream to form superfine fibers. During the spraying the microfibers may be mixed with rayon or other fibers and the mixture deposited on a moving belt in random distribution as a web. The microfibers are said to be unique in having a permanent electric charge, irregular length and diameters from 0.5 to 10 microns.

Due to the extreme fineness, the Avisco microfiber webs are highly absorbent and may be used in sanitary products, sterile absorbent, dentist rolls, inking pads, and typewriter ribbons. The static charge on the fibers renders the microfibers, alone or in blends, useful as high efficiency filters for gas, oils, water, dust and smoke. Uses are foreseen in air conditioning filters, gas masks, and filters for automobiles and trucks. Other possible uses are in nonwoven fabrics, insulation layers for sleeping bags and winter clothing.

American Viscose has already licensed the Mine Safety Appliance Corp., who are currently building a microfiber unit for the production of respiratory as well as space filters.

Epoxy preforms

Pellets consisting of a blend of epoxy resins, mineral fillers, and latent curing agents are now available from Magnolia Plastics Inc., Chamblee, Ga. Each pellet forms a premetered charge of resin plus curing agent, thereby eliminating the need for careful weighing of each component. According to the company, toxicity problems are removed and automation techniques are simplified. Various formulations are available, covering a range of cure temperatures from 200° to 370° F., and cure cycles from 10 to 30 minutes. Flame retardant systems can also be supplied. Applications for these pellets suggested by Magnolia include the production of carbon film resistors, capacitors, chokes, and adhesives.

New Companies

York Industrial Plastics Inc., Church Rd. and Derry Court, York, Pa., has been organized to manufacture a complete line of pipes and fittings, valves, and pumps lined with Bascodur, a high temperature, high chemical resistant phenolic which will be extruded under a license issued by **Sued-West-Chemie** of West Germany. The material is also said to have a potential as a shield for atomic reactors, and in the chemical processing industries. **George T. Stone** is president, and **R. A. Cottingham** is vice-president and general manager.

Artline-Kimball of California is a new corporation formed by **Kimball Mfg. Corp.**, San Rafael, and **Marplex Co.**, El **(To page 214)**

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Segundo, Calif. The new firm, with headquarters in El Segundo, manufactures and markets fibrous glass decorative accessories such as planters, casual serving pieces and trays.

Automatic Molded Plastics Co. Inc., 4628 W. Washington Blvd., Chicago, Ill., has been organized as an injection and blow molding company, and will also have full tooling facilities. **Morris Nozette,** president of the new firm. is also president of **Bradley Associates Inc.,** and **Ace Plastic Molding Co. Inc. Bernard Willow** is vice-president of the new company.

Industrial Plastic Molders Inc., 680 W. 18th St., Hialeah, Fla., was formed by **Russell, Burdsall & Ward Bolt & Nut Co.,** Port Chester, N. Y. and **Modern Designers,** Hialeah, to manufacture injection molded plastic parts. R. B. & W. holds controlling interest in the new company, successor to Modern Designers. The company will also design and make custom molds for injection molding. **Martin Dawson,** former head of Modern Designers, is president of the new firm.

Expansion

Enjay Chemical Co., a division of **Humble Oil & Refining Co.,** has announced completion of a 50% expansion of oxo alcohol capacity at Humble's Baton Rouge, La. refinery to a total of 90 million lb. per year. The expansion will meet the increased demand resulting from rapid growth in vinyl plasticizers and synthetic detergents. Enjay was the first marketer of commercial oxo alcohols, beginning in 1948 with isooctyl alcohol. Later, decyl and tridecyl alcohols were added to the company's line of products.

Samuel Moore & Co. has added 19,000 sq. ft. of manufacturing and warehouse space to existing facilities at Mantua, Ohio. This 70% expansion brings the company's total manufacturing, warehousing and office area to approximately 50,000 sq. feet. The company

manufactures Dekoron plastics covered metal pipe and instrument lines; and Synflex plastics extrusion specialties, including nylon paint spray hose and hydraulic hose.

Continental Oil Co. has purchased a 25% interest in **Carlon Products Corp.,** Aurora, Ohio producer of plastic pipe. Carlon employs approximately 330 persons and, in addition to the Aurora plant, has facilities in Corsicana, Texas; Asheville, N. C.; Compton, Calif.; Somerville, Mass.; and High Springs, Fla.

Eastman Chemical Products Inc. has started construction in Kingsport, Tenn. of new quarters for the sales, service, and product development laboratories of the Chemicals Div. Completion of the building is scheduled for early 1961. The new 60,000-sq.-ft. structure will house laboratories for the following groups: plastics—basic resins, plasticizers, inhibitors, and stabilizers; protective coatings — film-forming resins, solvents and modifiers; antioxidants—food-grade and industrial; functional fluids—hydraulic fluids and synthetic lubricants; and low molecular weight polyolefins—polishes, textile finishes and paper coatings, as well as facilities for paraffin additives.

Turex Plastics, Nasonville, R. I., a new wholly owned subsidiary of **Rexall Drug & Chemical Co.,** has started production of polyethylene packaging film. According to **Donald H. Brewer,** vice-president of Rexall Drug & Chemical Co., in charge of the Plastics Processing Div., the plant is equipped to produce either polyethylene or polypropylene film. **Robert F. Porter** is general manager, **Edwin (Ted) Fitzpatrick,** sales manager. Initially, approximately 25 persons will be employed at the Turex facilities. This figure may eventually rise to 100 or more.

Columbian Carbon Co. will construct a plant in the Houston area of Texas for the production of dispersions of carbon black in polyethylene, polypropylene, and other resins. The new plant will begin operation in **(To page 216)**

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the fourth quarter of 1960. It is designed for a capacity of approximately 8 million lb. a year and will supplement Columbian's existing production in Tacony, Pa.

Paramount Foam Industries has moved from 525 Oritan Ave., Ridgefield, N. J., to a 100,000-sq.-ft. factory at Mercer and Arnot Streets, Lodi, N. J. The company has been a manufacturer of polyester urethane foam for novelties, clothing interlining and packaging; and will now also produce polyether urethane foam for furniture cushioning, mattresses, and other allied fields.

Haveg Industries Inc. has completed new research and development laboratory facilities at its Taunton, Mass. plant. The new lab will be concerned with material, process and application development of plastics, elastomers, and ceramo plastics. The laboratory is organized as a section of the engineering department under the direction of **George S. Irby**, division manager of engineering.

The Kordite Co. has selected Macedon, N. Y. as one of three new half-million dollar warehousing sites. Occupancy for the 28,000-sq.-ft. structure is scheduled for early 1961. The new building will be part of a $1.5 million warehousing system reaching from Macedon through Jacksonville, Ill., to Woodland, Calif. These facilities will store all Kordite products, which include films and bags, and will permit same-day shipment for orders received from any point in the country, according to the company. Completion of Kordite's new warehousing system doubles its present storage capacity.

Textron Inc. has purchased the assets and business of the **Dorsett Plastics Corp.**, Santa Clara, Calif. builder of Dorsett Iso-Glas fibrous glass boats. Dorsett manufactures 9 models of outboard and inboard runabouts and cruisers in the 15-ft. and 21-ft. range, and last year its sales were approximately $2,-800,000. Sales are **(To page 218)**

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running 90% ahead of last year, the company states. Manufacturing facilities of Dorsett are presently located in Santa Clara and San Jose, Calif., and Bremen, Ind. The company plans establishment of a fourth manufacturing plant on the Eastern seaboard to augment existing production and distribution facilities. Dorsett will be run as a division of Textron, with no change in its present management or policy. The company will be known as **Dorsett Marine.**

Polymer Corp. has broken ground for a new plant in Northwestern Industrial Park, Rolling Meadows, Chicago. The principal operations at the facility will be plastic fluidized bed coating of metal products with the new Whirlclad Coating System and demonstration of the technique to prospective licensees who desire to use it in their own plants. The structure will also be used as a warehouse for Polypenco nylon, Teflon and other industrial plastic stock shapes. According to **Lucky W. Somers**, Chicago district manager of the Whirlclad Div., the new automated plant will provide custom coating facilities for applying vinyls, cellulosics, epoxies, nylon and other resins to metals for Midwestern industry.

The Polymer Corp. of Penna., Polymer's national subsidiary for semi-finished plastic shapes, will move its offices and warehouse from 3760 West Devon Ave., when the building is completed.

The Epoxylite Corp., formulator of epoxy resin compounds for the encapsulation of large electrical equipment and for various structural applications moved to larger quarters at 1428 N. Tyler, South El Monte, Calif. The new facility represents a 100% increase of lab, production and office space.

Hexcel Products Inc., Berkeley, Calif. manufacturer of honeycomb materials, has purchased the assets of **Applied Plastics Co. Inc.**, El Segundo, Calif. producer of adhesives, coatings, foams, and hardening systems for epoxy resins. APCO will be **(To page 220)**

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a division of Hexcel Products Inc. under the direction of **F. George Firth**, founder and former president, who becomes a vice-president of Hexcel.

Plastic Molding Powders Inc. moved from 2004 McDonald Ave., Brooklyn, N. Y., to 487 Forest St., Kearny, N. J., and has increased floor space from 15,000 sq. ft. to 60,000 sq. feet. The company is a custom reprocessor.

Hooker Chemical Corp. plans a new multi-million dollar facility in South Shore, Ky. to produce synthetic phenol. The new plant will be operated by the **Durez Plastics Div.** Construction is expected to be completed by the end of 1961. Durez has a large and growing captive use for phenol at N. Tonawanda, N. Y., and at its automated molding compounds plant at Kenton, Ohio, some 150 miles from South Shore.

Tube Turns Plastics Inc. is expanding its Louisville, Ky. plant by adding 6400 sq. ft. to increase manufacturing, raw material and warehouse space by approximately one third. The company produces injection molded unplasticized PVC fittings, flanges, and valves for industrial piping, and fittings and pipe made of Penton chlorinated polyether plastic, PE and other injection molded thermoplastic products.

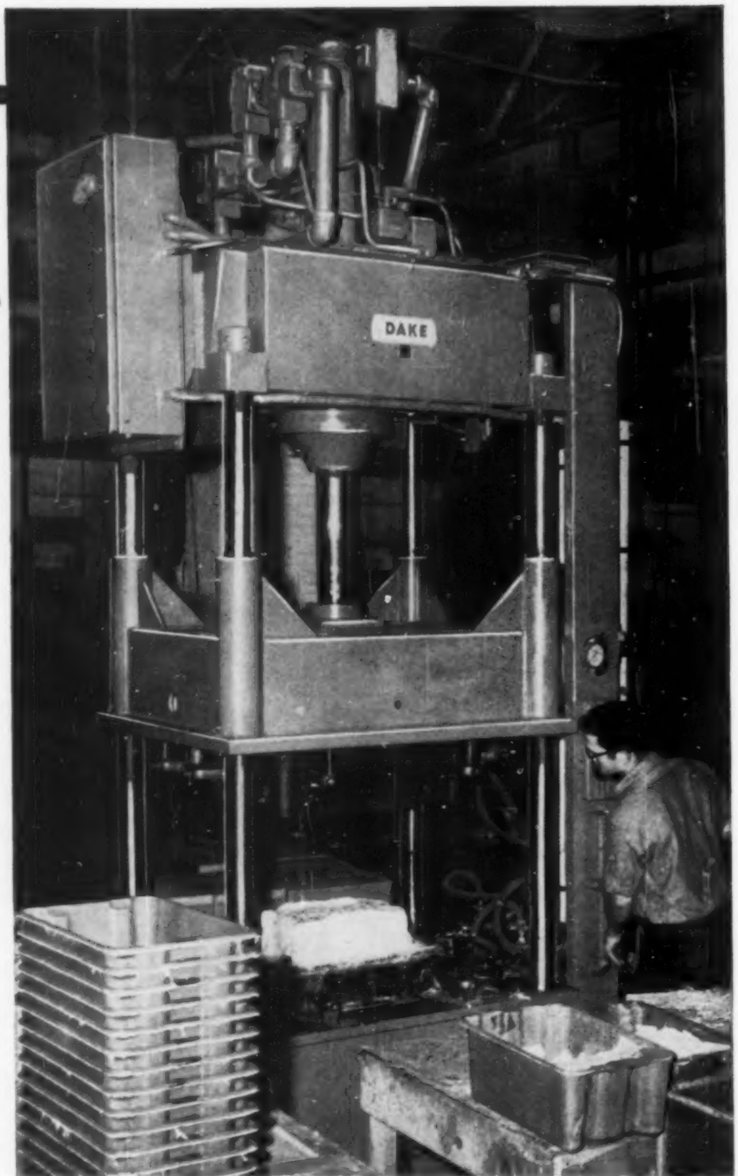
Continental-Diamond Fibre Corp., a subsidiary of **The Budd Co.**, has broken ground for additional treating and press equipment for its laminated plastics products. This latest program entails the expenditure of approximately $1,250,000. CDF is centralizing all of its Dilecto laminated plastic manufacturing and fabricating facilities at its headquarters plant in Newark, Del.

Allied Chemical Corp. and **Polymer Corp. (Pty.) Ltd.** of Australia plan to form a joint company, **Allied Polymer Pty. Ltd.**, to manufacture nylon tire cord, monofilament, and molding compounds. The plant **(To page 223)**

Speed... Precision... Versatility

DAKE

Reinforced Plastic Molding Presses



75-Ton Dake Guided Platen Plastic Molding Press forming Stack-n-Nest tote pans at G. B. Lewis Company, Watertown, Wisconsin.

GUIDED PLATEN—Assures accurate alignment.

AUTOMATIC, SEMI-AUTOMATIC, OR MANUAL CONTROL—For production or experimental work.

FAST RAM APPROACH—Allows for fast closing and return of movable platen. Slows automatically as work is approached.

ACCURATE, CONTROLLED PRESSURES—Give maximum on-the-job flexibility.

ELECTRIC TIMER—Holds pressure during curing cycle—adjustable from 3 seconds to 20 minutes. Ram returns automatically.

ADJUSTABLE STROKE CONTROL—Provides for automatic ram slowdown before contacting work.

ADJUSTABLE PRESSURE—From ⅓ press capacity to full press capacity.

Dake Guided Platen Presses are the latest development in the reinforced plastic molding field. They are job engineered to help you meet all molding requirements, as well as speed production output, and reduce operating costs. Their all-steel construction with long tie rod bearings and larger diameter tie rods provide maximum rigidity to assure extremely accurate work with all types of plastic forms. Standard models are electric-hydraulic in operation and available in capacities from 25 tons to 600 tons. Write for Bulletin 405.

Hand-Operated Hydraulic | Power-Operated Hydraulic | Guided Platen | Gap Type Presses | Movable Frame

DAKE PRESSES

DAKE CORPORATION
648 Robbins Road
Grand Haven, Mich.

THE PLASTISCOPE

(From page 220)

will supply current needs of the Australian market with provision for rapid expansion as the demand increases. Polymer Corp. is a major manufacturer of organic chemicals and plastics with plants in Sydney, Australia and Auckland, New Zealand and distribution centers in all the Australian capital cities. Pending the start-up of the jointly owned Australian facilities, Polymer Corp. will market the Plaskon molding compound made in Virginia.

Ellay Rubber Co., Los Angeles, Calif., has installed a Farrel-Birmingham calender capable of a daily production of 50,000 lb. of vinyl sheeting and film, in widths up to 60 inches. A building with 15,000 sq. ft. has been added to house the new equipment.

Ferro Corp. has appropriated $2 million for an expansion of the Fiber Glass Div. plant in California. Bushings for drawing continuous glass fiber strands and a glass melting tank will be installed. The plant now fabricates reinforcements for plastics from fibers supplied by the division's main plant in Nashville, Tenn. In the past three years, the company has invested $6 million in the expansion of the Fiber Glass Div.

The Color Div. of Ferro has completed a $60,000 expansion of its laboratory facilities in Cleveland, Ohio for the development of coloring techniques for plastics and other materials.

Webster Industries Inc., Salem, Mass. PE extruder and converter, has acquired the Converting Div. of **Shore Line Industries Inc.**, film-making subsidiary of **Portco Corp.** Webster took over Shore Line's converting equipment and moved it to its Salem plant, and also took over the accounts for that operation. Shore Line's PE extrusion operation is not included in the transaction and will remain at the Clinton, Conn. plant.

Risdon Mfg. Co., metal fabricator in the small components, aerosol, cosmetic containers, notions, and wire novelties (To page 224)

THE PLASTISCOPE

(*From page 223*)

fields, has added a Plastics Division at Naugatuck, Conn. Established to serve its own need for plastic components used in conjunction with metal parts, the new division will also produce plastics parts for other companies. New high-speed, fully automatic injection molding machines of 3, 4, and 6-oz. capacities have been installed. The plastics operation is being expanded and it is estimated that its output will represent about 25% of the company's Naugatuck plant production by about 1965, the company states.

The new division is producing components of nylon, polyethylene, polystyrene, and Delrin, including valve actuators, cores, cups, and dust covers for the aerosol division, nylon self-covered buttons for the notions division, and the barrel, plunger, and plug for a new roll-on lipstick case for the cosmetics division.

Deceased

Robert D. Noyes, member of the sales department of **Union Carbide Plastics Co.** for 24 years, died May 31, after a heart attack.

James M. Scott, 50, general plant manager and treasurer of **Scott Testers Inc.**, Providence, R. I., and president of **Scott Testers Southern**, Spartanburg, S. C., died of a heart attack on June 19.

Meetings

Plastics groups

Sept. 8, 9: Society of Plastics Engineers Inc. (S.P.E.), Eastern New England Section, "New horizons in vinyl and plastics in the shoe industry," Statler-Hilton Hotel, Boston, Mass.

Sept. 14, 15: Finnish Plastics Assn. (Muoviyhdistys), International Plastics Convention, Helsinki, Finland.

Sept. 16-Oct. 2: Finnish National Plastics Exhibition and Finnish Industries Fair, Helsinki.

Sept. 22: S.P.E. Binghamton Section, "Plastics in business machines," Sheraton Inn, Binghamton, N. Y.

Oct. 5: S.P.E Golden Gate Section, "Plastics ver- **(To page 227)**

THE PLASTISCOPE

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sus corrosion," Mark Hopkins Hotel, San Francisco, Calif.

Oct. 13, 14: The Society of the Plastics Industry Inc. (S.P.I.) 16th Annual New England Section Conference, Wentworth-by-the-Sea, Portsmouth, N. H.

Oct. 17-19: International Congress 1960 on the Technology of Plastics Processing, Koninklijk Instituut voor de Tropen, Mauritskade 63, Amsterdam, Holland.

Oct. 19-26: International Plastics Exhibition, "macroPlastic 1960," Croeselaan exhibition grounds, Utrecht, Holland.

Nov. 30-Dec. 2: British Plastics Federation, 2nd International Reinforced Plastics Conference, Cafe Royal, London, England.

June 5-9, 1961: S.P.I. 9th National Plastics Exposition and National Plastics Conference, Coliseum and Commodore Hotel, New York.

Other groups

Sept. 11-16: American Chemical Society, 138th Annual Meeting, and "Chemical Exposition U.S.A. 1960," Sept. 13-15, Statler Hilton Hotel, New York, N. Y.

Oct. 9-11: American Society of Mechanical Engineers, in cooperation with the National Rubber & Plastics Professional Div. of A.S.M.E., Rubber & Plastics Conference, Hotel Lawrence, Erie, Pa.

Oct. 14-23: French Packaging Institute, "Autopac" 1st International Packaging Machinery Show, and 14th French Packaging Show, Paris, France.

Oct. 17-19: Technical Assn. of the Pulp & Paper Industry (TAPPI), 15th Plastics-Paper Conference, Hotel Syracuse, Syracuse, N. Y.

Oct. 17-22: International Standards Organization, Plastics Technical Committee, 10th Annual Meeting, Prague, Czechoslovakia.

Oct. 25-27: American Standards Assn., 11th National Conference on Standards, including Building Sessions sponsored by the Modular Building Standards Assn. on the need for standardization in building. Sheraton-Atlantic Hotel, New York, N. Y.—**End**

COMPANIES...PEOPLE

Appointments, promotions, and relocations in the plastics industry.

Koppers Co. Inc., Plastics Div.: H. D. Cooper named asst. sales mgr. He is succeeded as PE product mgr. by **M. D. Fullerton**, former mgr., New England dist. sales office, who was replaced by **E. C. Hilkert. D. G. Harris** succeeds Mr. Hilkert as mgr., div. sales office.

Mobay Chemical Co., Pittsburgh, Pa.: **Robert D. Karns** appointed sr. process chemical engineer, and **David C. Owens** joined the process design section, Engineering Dept. Mobay manufactures raw materials for urethanes and produces polycarbonate resins.

Commercial Plastics & Supply Corp., New York, N. Y., has opened a sales and service branch and warehouse at 29 Fitch St., New Haven, Conn. **Herbert Weil** was appointed gen. mgr.

The Kordite Co., Macedon, N. Y., appointed **Melvin S. Cagen** plant tech. supt. of mfg. facilities; **William E. Schreck**, product mgr. of the Flexcord Div.; **John W. Bunker**, named field sales rep. of the industrial div., with headquarters in Denver, Colo.

The Industrial Chemicals Div. is the new name of **Archer-Daniels-Midland Co.'s** chemical products mfg. operations. The Div. produces Admex vinyl plasticizers, as well as a line of chemical intermediates for industry. **Dr. George K. Nelson** is mgr. ADM recently announced that the Industrial Chemicals Div. will construct a multimillion dollar chemical center at Peoria, Ill.

Society of Plastics Engineers Inc. has formed an Arizona Section. **Samuel Windman, Phoenix Plastics,** is pres.; **Ted W. Kerr, Arizona Plastics Extrusion Co.**, is v-p; **Don H. White, University of Arizona**, secy.

Intercontinental Chemical Corp. subsidiaries, **Carbic-Hoechst Corp., Hostachem Corp.,** and **Hostawax Co.** moved to 270 Sheffield St., Mountainside, N. J. These companies are tech. reps and distributors for **Farbwerke Hoechst AG.**, and its subsidiaries in West Germany, as well as for **Hoechst Chemical Corp.**, West Warwick, R. I. Exec. offices of Intercontinental remain at 350 Fifth Ave., New York, N. Y.

Eastman Chemical Products Inc., Kingsport, Tenn.: **John H. Sanders** named sales mgr. of the chemicals div., succeeding **Guy A. Kirton**, who will concentrate on international sales of Tennessee and Texas Eastman products. **Nelce C. Taylor**, formerly Pacific Coast service engineer for Tenite plastics in Los Angeles, Calif., exchanged assignments with **Floyd Patrick**, service engineer in the Chicago, Ill. dist. office.

G. T. Schjeldahl, Northfield, Minn., mfr. of inflatable structures, established a West Coast sales and service group. **Donald J. Owen** named West Coast sales mgr. Offices will be set up in Los Angeles and San Francisco, Calif. in the near future.

H. Muehlstein & Co. Inc., dealer and distributor of plastics and rubber raw materials, moved its Chicago, Ill. headquarters from 327 S. LaSalle St. to 221 N. LaSalle St.

Brilhart Plastics Corp., Mineola, N. Y. industrial custom molder, is under new management. **Philip Kahn** is pres., and **Gilbert Kahn** was named v-p.

The Dow Chemical Co.: J. L. Johnson, economic evaluation engineer, Freeport, Texas div., transferred to Midland, Mich. to become plastics section head, market research staff.

American Cyanamid Co.: T. Dean Smith appointed mgr., petrochemicals dept. He will be located in the New York, N. Y. office.

Formica Corp.: John C. Pitzer promoted to mgr., industrial product application. He is succeeded by **Eldon E. Fender** as mgr., industrial process engineering.

Marbon Chemical Div., Borg-Warner Corp.: John A. Helgesen appointed product applications engineer. **Richard L. Reid** and **John M. Avery** appointed tech. sales reps., in Mich. and Ind. respectively, for Cycolac ABS plastics.

Olin Mathieson Chemical Corp.: Dr. Herman A. Bruson appointed v-p for research, Chemicals Div. **Dr. A. E. Ardis** named dir., polymers research dept.

Union Carbide Plastics Co.: Howard Bassett promoted to development dept., at Bound Brook, N. J. **John H. Rieckers** appointed tech. sales rep., metropolitan N. Y. region.

Du Pont Co.'s Film Dept. appointed **Dr. Arthur B. Ness** mgr., new product development, and **Harry S. Carl Jr.** product mgr. for Mylar and Teflon film in the sales div.

The Richardson Co.: Howard Primack joined the R & D div. and will be responsible for product and process development of plastic materials. **Ramon A. Mulholland** appointed mgr., commercial development dept.

National Starch & Chemical de Mexico, S.A. de C.V. is the new name of **Polimeros, S.A.**, Mexico City producer of PVAc polymers, copolymers, and adhesives.

Lasco Industries is the new name for **Lynch Asbestos Co.**, Los Angeles, Calif. mfr. of fibrous glass building panels and plastic pipe.

Weldotron Corp., Newark, N. J., is the new name of **Plastic Welding Corp.**, mfr. of custom equipment for plastics, woodworking, electronics, and chemical industries.

Pacific Moulded Products Co., Los Angeles, Calif. mfr. of plastic and rubber parts for aircraft, industrial, and military applications, appointed **Norman A. Klemp** plant mgr., and **Robert S. Lundgren** chief engineer.

Plast-O-Craft Inc. moved from 503 McCarter Highway to larger quarters at 391 Mulberry St., Newark, N. J. Sales of the company's vacuum forming equipment are being handled by **Kinne Sales Engineering Co.**, 10 Brookfield Rd., Upper Montclair, N. J.

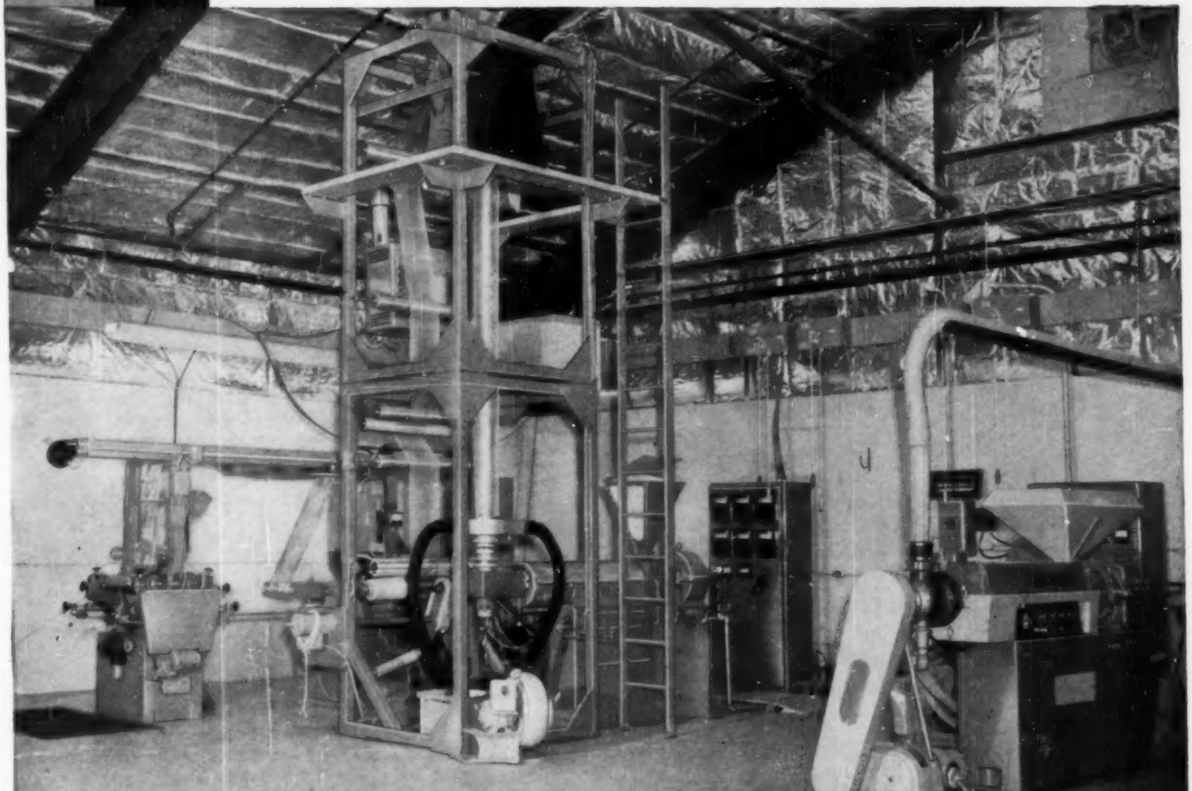
Allied Chemical, National Aniline Div.: Robert L. Axtell appointed plant mgr., and **Charles D. Smith**, asst. plant mgr. of the isocyanate plant at Moundsville, W. Va.

The Society of the Plastics Industry (Canada) Inc.: Adolph Monsaroff, Monsanto Canada Ltd., elected pres.; and **E. G. Salmond, Canadian Plastics**, elected v-p.

Monsanto Chemical Co., Plastics Div., Springfield, Mass.: **Dr. Gabriel M. Grudus Jr.**, and **Walter L. Zimmerman** joined the research dept. **Dr. Rudolph L. Heider** appointed an assoc. in the development dept. He will be responsible initially for the div.'s polystyrene foam development program and will serve as liaison with the company's Research & Engineering Div. **Ronald G. Spann** and **Robert A. Woodhead** joined the tech. services dept. **Lawrence R. Archer** joined the sales dept.

Plastics Div., Texas City, Texas: **Allen C. Ludwig** and **Robert D. McCullough** joined the mfg. dept.

Airthane, a wholly owned subsidiary and div. of the **Pelron Co.**, Lyons, Ill., appointed **Edward A. Bowditch**, v-p in the N.Y. **(To page 230)**



A portion of the Hartig Laboratory showing an extruder, blown film tower, and a Rotobag bag-making and printing machine. At right is a new "T" line extruder with the new Hartig underwater pelletiser.

COMPANIES ... PEOPLE

(From page 228)

office. and **James R. Wilson,** v-p at Lyons, to the board of directors. Airthane is a mfr. of polyether foam.

Cooke Color & Chemical Co., Hackettstown, N. J., established a color matching laboratory service to produce exclusive and proprietary color combinations for use with polyethylene, styrene, and other plastics, and natural and synthetic rubber.

Erie Engine & Mfg. Co., Erie, Pa., is under new management. **S. N. Bolling** is pres.; **Bernard Sobieraj,** v-p; **R. E. Weller,** gen. mgr.; and **Thomas Kramer Jr.,** sales mgr.

Charles C. Colozzi elected pres. of **U. S. Gasket Co.,** Plastics Div. of **Garlock Inc.** He succeeds **A. J. McMullen,** who resigned as U. S. G. pres. to devote full time to his position as pres. and chief exec. officer of Garlock Inc.

R. G. Richards, formerly mgr. of planning and development, Plastics Div., appointed to newly established position of dir. of development by **Diamond Alkali Co.**

John D. McPherson elected pres. and a dir. of **Jefferson Chemical Co. Inc.,** succeeding **George R. Bryant,** retired. Jefferson Chemical Co., with headquarters in Houston, Texas, is a producer of polyethers and catalysts for urethane foam as well as propylene chemicals.

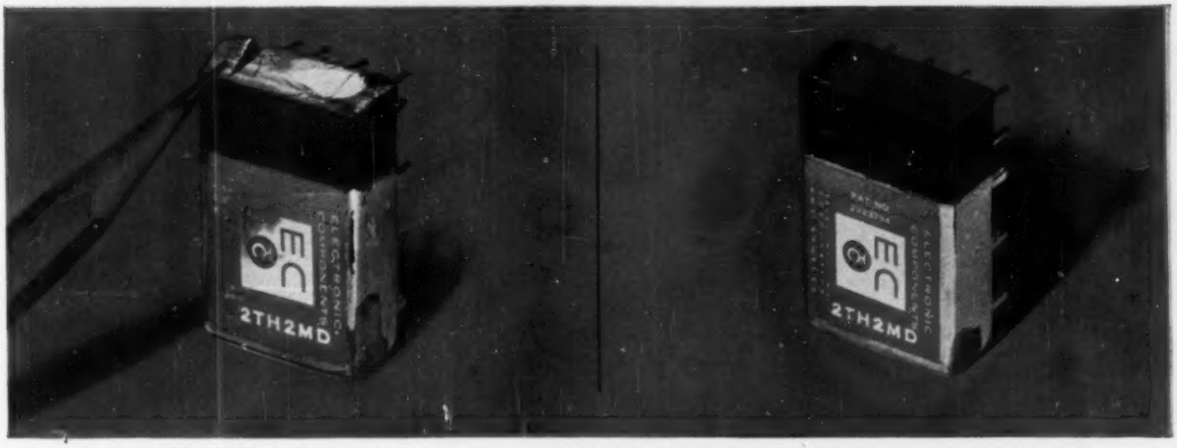
Carl E. Drugge appointed works mgr. of the Compton, Calif. plant of **The Borden Chemical Co.,** div. of **The Borden Co.** The Compton operation produces urea and phenolic resins, polyvinyl acetate emulsions, casein products, vinyl extrusions for electrical insulation, and consumer garden hose and sprinklers.

Wesley T. Bailey named product specialist in the Surface Coatings and Plastics Chemicals Div. of **Oronite Chemical Co.,** a subsidiary of **Standard Oil Co. of California.** He will be concerned primarily with improving techniques for production of plastics materials and coatings employing isophthalic as a base material.

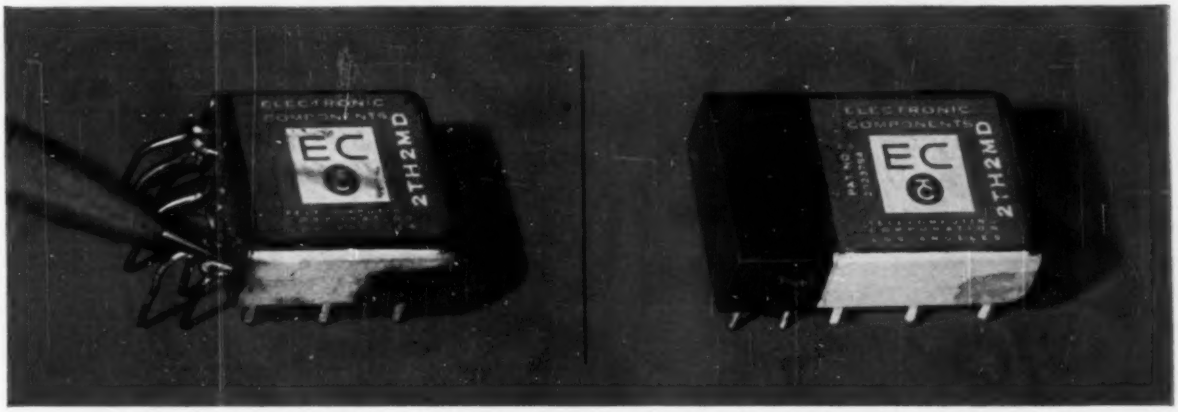
H. Fred Klintworth named product mgr., plastics sales, for the mechanical goods div., **U. S. Rubber Co.,** at its Passaic, N. J. plant. Plastics fabricated at Passaic include Uscolite pipe, valves and fittings, slab stock, etc., made of unmodified PVC and ABS copolymer blend.

Don Prideaux appointed mgr. of the Eastern Div. of **Rezolin Inc.,** Santa Monica, Calif. plastic compound formulator. He will head **(To page 233)**

DOW | **THERMOSETTING RESINS**



Under 180°C. heat, the ordinary epoxy resin cracked . . . but the epoxy novolac potting was unharmed!



In an epoxy stripper, the epoxy resin potting dissolved . . . but the epoxy novolac showed no significant change after two weeks' immersion!

DOW EPOXY NOVOLAC UNHARMED

by brutal heat and chemical torture tests!

Tests conducted by an electronics component manufacturer prove it! Compared on the basis of their ability to withstand extreme heat and powerful chemical attack, these two microminiature relays demonstrated the amazing difference between a regular high-quality epoxy resin, and Dow epoxy novolac resin (D.E.N. 438).

The test to determine the effects of prolonged intense heat on these two terminal pottings took place in a 180°C. oven. After five hours, the ordinary epoxy resin potting compound cracked. But after 100 hours of continuous 180°C. heat, the Dow epoxy novolac was unharmed!

A chemical resistance test compared the ability of each potting compound to withstand the action of high-powered stripping solvents similar to solvents used in cleaning electronics equipment. The ordinary epoxy resin formulation was completely dissolved after only 48 hours in the stripper. But the Dow epoxy novolac potting showed no significant change, even after two weeks' immersion!

These results prove once again that in potting, molding, encapsulating and laminating, or in any application where performance is critical, Dow epoxy novolac resins can provide the extra measure of physical and chemical stability necessary for success.

New applications for the complete Dow family of thermosetting polymers are being uncovered every day. If you have a problem that could benefit from their hardness, toughness, dimensional stability, and chemical resistance, call your nearest Dow sales office. Or write: THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Merchandising Department 1965CS8.

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COMPANIES...PEOPLE

(From page 230)

the company's new office and warehouse facility at 155 Washington St., Newark, N. J.

Kenneth G. Michel appointed v-p and asst. gen. mgr. of the **Bradley-Sun Div., American Can Co.**, at Maynard, Mass. The Div. manufactures plastic tubes and bottles.

Dr. **Mandell S. Ziegler**, previously with the research and sales divs. of Du Pont's polychemicals dept., appointed dir., R & D, for **Russell Reinforced Plastics Corp.**, Lindenhurst, N. Y. custom molder.

Jameson Crane, formerly div. sales mgr. of Columbus Coated Fabrics Corp., joined **Crane Plastics Inc.**, Columbus, Ohio custom extruder.

David A. Daniels appointed Southwest area rep. out of the Dallas, Texas sales office of **Coast Mfg. & Supply Co.**, Livermore, Calif. mfr. of fibrous glass and resin impregnated fabrics, and molding compounds for use in missiles, aircraft, and other industrial products.

Dr. **Earl W. Lane** joined **Escambia Chemical Corp.** as mgr., new product development, Commercial Development Dept.

Dwight G. Barnhart, formerly a dist. rep. for **Continental-Emsco Co.**, promoted to sales mgr. of **Fibercast Co.**, Sand Springs, Okla. Fibercast, mfr. of reinforced epoxy resin pipe and fittings, is operated by Continental-Emsco. Both are divs. of **The Youngstown Sheet & Tube Co.**

Robert E. Ward appointed plant mgr., **The Carwin Co.**, North Haven, Conn. mfr. of specialty isocyanates, high temperature polyurethane foam systems, and organic chemicals.

Henry J. McCabe appointed v-p in charge of production and mfg., **Timely Technical Products Inc.**, Verona, N. J. mfr. of Teflon products.

Dr. **John R. Nazy** named project leader in the polymer research dept. by **General Mills Inc., Central Research Laboratories**, Minneapolis, Minn.

G. G Welch, elected pres. of **The Watertown Mfg. Co.**, Watertown, Conn. custom molder and extruder. Mr. Welch has been with Watertown since 1942.

A. W. Schubert, formerly exec. v-p, elected pres. of **Emery Industries Inc.**, Cincinnati, Ohio producer of chemicals for industry.

Dr. **J. L. Azorlosa** named to newly created position of program mgr.—polymer research, at (To page 235)

COMPANIES...PEOPLE

(From page 233)

the **Central Research Laboratories**, Easton, Pa., by the **Dyestuff & Chemical Div., General Aniline & Film Corp.**

Dr. Brage Golding, head of Purdue University School of Chemical Engineering, Lafayette, Ind., appointed consultant in plastics for **Vulcan Corp.**, Cincinnati, Ohio, injection molders and mfrs. of shoe heels.

Charles M. Travis appointed v-p in charge of the Industrial Products Div. of **Hess, Goldsmith & Co.**, mfr. of woven fibrous glass cloth and fibrous glass tapes.

Jay P. Eggert, formerly prod. supt., chemicals, appointed works mgr. of the new synthetic phenol plant to be constructed near South Shore, Ky., by **Durez Plastics Div., Hooker Chemical Corp.**

Calvin Larsen appointed mgr. of the Palo Alto, Calif. branch of **The Mica Corp.**, Culver City, Calif. producer of epoxy glass laminates.

Lloyd C. Adam appointed mgr., Rubber & Plastics Machinery Div. of **Taccone Corp.**, North East, Pa., whose line includes standard presses for compression, transfer, and reinforced fibrous glass molding.

James P. Reeves elected a dir. and v-p, sales and market development, at **Como Plastics Inc.**, Columbus, Ind. injection molding firm.

Jack Wyckoff joined **M. C. Gill Corp.**, El Monte, Calif. fibrous glass and honeycomb laminator, as asst. sales mgr.

Thomas G. Gibian, gen. mgr. of the Organic Chemicals Div., appointed a v-p of the **Dewey & Almy Chemical Div., W. R. Grace & Co.**, Cambridge, Mass.

William I. Hollar, gen. mgr. of **Jomac-North Inc.**, Warsaw, Ind., elected v-p of the company, a subsidiary of **Jomac Inc.**, Philadelphia, Pa. Jomac-North manufactures PVC work gloves and clothing.

Harry J. Pratt appointed gen. mgr., plastics divs., **Amos-Thompson Corp.**, Edinburg, Ind.

New reps.

Rezolin Inc., Santa Monica, Calif. formulator of plastic compounds, appointed **Kruse Pattern Works**, Pennsauken, N. J., as special rep. to the pattern trade; **Aeromart Inc.**, Atlanta, Ga., and Huntsville, Ala., as reps. in the Southeastern states; and **Nick Gligora**, Pinellas Park, Fla., as Fla. rep. . . . **Grandberg Bros.**, 268 Summer St., Boston, Mass., will handle distribution of **The General Tire & Rubber Co.'s** "Fashon" vinyl wall covering in the New England area. . .

Tommy Tucker Plastics, Dallas, Texas, named distributor for Campco thermoplastic sheet and film manufactured by **Chicago Molded Products Corp.** . . . **Harwick Standard Chemical Co.** appointed distributor of Aldor deodorants and scents to the plastic and rubber industries for **Alpine Aromatics Inc.**, Metuchen, N. J. . . . **Velcro Corp.** appointed **Apex Coated Fabrics Co. Inc.**, 12-16 E. 22 St., New York, N. Y., and **John Boyle & Co. Inc.**, 112 Duane St., New York, exclusive reps. in the U. S. for Velcro's nylon tape fastener to the canvas goods and awning industries; and luggage and leather carrying case industries; respectively. . . .

DeWitt Plastics, Auburn, N. Y., appointed **Mel Barr Co.**, Seattle, Wash., as rep. in the 13 Western states and Hawaii, for its line of floating, shatterproof plastic fly and lure boxes. . . . **Seaporcel Metals Inc.**, Long Island City, N. Y., named exclusive distributor of Rite-Lite acrylic plastic skylights for **The By-Products Co.**, Landover, Md.—**End**

What is "DYNA-MELT"?

DYNA-MELT is a MEIKI trademark for injection unit which assures perfect melting of plastic materials by adopting a screw of two different functions — melting and injecting — with a hydraulically balanced thrust bearing.

Check these DYNA-MELT features:

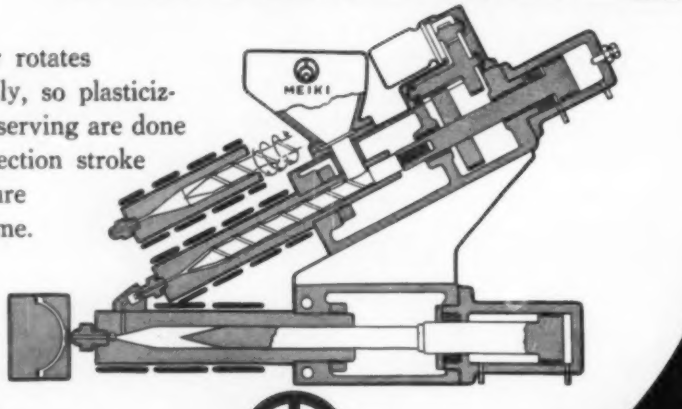
* Perfectly uniform melting
* Perfect mixing and conditioning of material — no risk of decomposition
* Increased plasticizing capacity
* Less vaporization or air bubbles
* Perfect dry-coloring
* Improved quality of moldings
* Heat economy
* Injection under pre-set pressure, lower than for conventional injection units
* Less clamping force needed for moldings of same projected area
* Less internal stress inherent to low-pressure injection
* Less injection problems with technically-difficult moldings
* Materials difficult of molding (e.g. unplasticized PVC) injected with ease
* Continuous running of screw, even during injection or holding time, assures perfect melting and decreases cycle time
* Hydraulic piston incorporated to screw shaft solves thrust difficulties

PCS Type

INJECTION MACHINE

"DYNA-MELT"

The screw rotates continuously, so plasticizing and reserving are done during injection stroke and pressure holding time.



MEIKI

All these DYNA-MELT features are the result of continued technical research and are protected by various patents.

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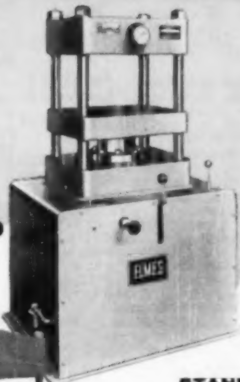

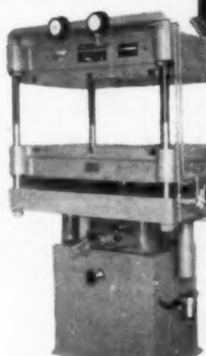

The full oil-hydraulic press without motors or pumps—operates directly from your shop air line. Metalworking or plastics, job shop or production.

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VERSATILE . . . EASY TO OPERATE

and MAINTAIN

STANDARD MODELS —like this 50-ton HYDROLAIR® —are built in 30, 50, 75, and 100-ton sizes. 50-ton model is also available with electrical control.

SPECIAL DESIGNS — like this 30-ton model with extra large 36" x 24" platen —to suit specialized requirements in production work or laboratory research.

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KING Vertical Boring and Turning Machines

American Steel Foundries, ELMES/KING DIVISION, 1159 Tennessee Avenue, Cincinnati 29, Ohio

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Machinery and Equipment For Sale

FOR SALE: INJECTION MOLDING MACHINES for sale. Two Reed Prentice #300 TA 12-16 oz., late 1957, late 1956. Four Reed Prentice 10D 8 oz. 1946. One DeMattia 12 oz. 1946. Also auxiliary equipment and molds. Reply Box 6639, Modern Plastics.

FOR SALE: TWO REED PRENTICE INJ. MOLDING machines, model 10D-12 oz. (1954), complete with instruments, controls, etc. for immediate removal. Both machines are in excellent condition and priced reasonably. Call, write, or phone for appointment to see in operation before removal. Rogers Plastic Corp., Ask for John Krach, W. Warren, Mass., HEmlock 6-7744.

FOR SALE: LABORATORY, PILOT plant & production equipment. Instron Floor Model TT-C; Atlas Weatherometer Model DMC-HR; 60 lb. Rigid Urethane Foam Machine & 20 lb. Newton Urethane Foam Metering & Mixing Machine, both with traverse, auto. timers & controls; Lanly Dry & Humid Oven with dry & wet bulb recording; Minn.-Honeywell Recording Potentiometer; Explosion Proof Admiral Refrigerator; Dillon Floor Model L Dynamometer; Zeiss Mono. Microscope; Danley ASTM Compression Set Dies; Scientific Model 161 Constant Temp. Bath; DeVilbiss Resin Spray Unit with tanks & 3 Dual Guns; 3 Monorail Systems, hoists, motors, & additional misc. equipment. Equipment approx. three years old. Condition excellent. Englander Plastics Div., 330 N. Warwick Ave., Baltimore 23, Md.

FOR SALE: VACATION SPECIALS. 8 oz. Reed Prentice injection molding machine, model 10D8, Double Link. Complete with wheelco controls. Stokes Model R and Colton Model 4½ T, Single Punch Tablet Presses. Individually motor driven. Ball & Jewell #1½ Rotary Scrap Cutter. Direct coupled to 25 HP motor. Extra knives and screens. LaRose Electronic Preheaters, 2KW and 4KW in stock. 50 Ton Standard and 75 Ton Watson Stillman Automatic Molding Presses. Fully self-contained, complete with timers and push buttons. Cumberland #1½ Rotary Scrap Cutter with 10 HP motor. Also in stock: NRM 2½", Royle 3¼", Hartig 3¼", and Adamson 6" Extruders. Also a complete line of blenders, mixers, scrap cutters, etc., for the plastic and rubber industries. What do you need? What do you want? We will finance. Johnson Machinery Company, 90 Elizabeth Avenue, Elizabeth, New Jersey EL-izabeth 5-2300.

FOR SALE: HPM 150H 6A 6/8 oz. '55, complete, excellent, $8,905. HPM 300 HV 12/16 '58. R.P. 300T 12/16 '54. NRM & Aetna Std. 4.5" Extruders, integral vacuum forming. Send for list 100 injection, compression, extrusion machines—available thruout U.S.A. Fred C. Ziesenheim M.E., 523 King Av. Marion, Ohio.

FOR SALE: HEAT SEALER, Never used continuous band type, will seal any material that is heat sealable. Wheelco control. Hydrawlik, 131 E. 1st Ave., Roselle, N. J.

FOR SALE: SPROUT-WALDRON 335 cu. ft. Unused horiz. ribbon blender. Sturtevant #9 150 cu. ft. unused rotary blender. Baker-Perkins #15-UUMM 100 gal. Dispersion blade mixer, jkt., 100 HP, cored blades, comp. cover. Stainless Reactors or Resin Kettles: 3500, 1900, 750, 500 gal., jktd. and agit. Perry Equipment Corp., 1429 N. 6th St., Phila. 22, Pa.

FOR SALE: QUALITY EQUIPMENT at reasonable prices. Mills: F-B. Unused 2 Roll 14" x 30" Late Type with Uni-Drives. Also 16" x 36"; 18" x 42"; 22" x 60". Calendars: 12" x 24"; 22" x 58". Extruders: NRM 1½" with vari-drive, NRM 6" Rubber Tuber with 75 HP motor, Hydr. Vertical 15" Extruding Strainer. Vulcanizers: 6' x 16' and 18' ASME. Presses: Stokes Model 280; 4" dia. Pre-Form; Colton Model 5½ Pre-Form Press; 3 French Oil Presses, 10" Ram; Dunning & Boschert Presses; 12" Ram; Stewart-Bolling 22" Ram; 36" x 36"; 6 Southwark Presses; 14" Rams; 36" x 36"; HPM 300 Ton Compression Moulding Press 4 Post, complete; HPM Size 1200 H 60 A Injection Moulding Press; 60 oz., 100 HP motor. Mixers: Baker Perkins Heavy Duty Double Arm Mixers up to 300 Gal.; Banbury No. 9; Day 40 Gal. Pony Mixers; New Falcon Ribbon Mixers; all sizes. Special: F-B Belt Press 52" x 31' 2 opngs. Impregnators: Stokes Dbl. Chamber 5648 Utility Rubber Stock Cutter; conveyors First Machinery Corp., 209-289 Tenth St., Bklyn. 15, N.Y. ST. 8-4672.

FOR SALE: THERMOTRIM DIE CUTTING press 36 x 53. Good condition. Ullman Co., 319 McKibbin St., Bklyn. 6 N. Y. HY 7-3700.

FOR SALE: NATURAL REPROCESSED Linear Polyethylene, Phillips type, .7 to 1.0 melt index, blow molding, extrusion, injection molding. Half a million pounds available, low price. Reply Box 6611, Modern Plastics.

FOR SALE: MPM 3½" WIRE covering extruder. New ¾" Plastic Extruder. Other sizes up to 6". Seco 6" x 12" and 8" x 16", 2-Roll Mills and calenders and other sizes up to 60". W.S. 240 ton, ten 24" x 56" platens. W. & W. 200 ton, 24" x 42" platens. Stokes Standard 150 ton Semi-automatic. French Oil 120 ton self-contained, 120 ton Upstroke, 29" x 21" platens, 10" stroke. 60 ton Farquhar 50" x 50" platens, 30" stroke. Stokes 50 ton Semi-automatic 22" x 12" platens. 50 ton Birdsboro 24" x 20" platens. 30 ton Birdsboro 21" x 14" platens. Hydraulic pumps and accumulators. 60" Spreader Heads with XP motors. Despatch elect. heated ovens and other types. New ¾ oz. Bench Model Injection Molding Machines. Van Dorn 1 & 2 oz. Injection Molding Machines, other sizes to 100 oz. Baker-Perkins and Day jacketed Mixers. Plastic Grinders. Stokes RD3 Rotary-Preform Tablet Machine, also single punch ½" to 4". Send for listings. We buy your surplus machinery. Stein Equipment Company, 107-8th Street, Brooklyn 15, New York.

INJECTION MOULDING MACHINERY BARGAINS. Plastics manufacturer has surplus used injection moulding machines available at sacrifice prices. Included are 6 oz. Lester, 8, 10 and 16 oz. Reed. All units in good condition. Write M. Wintrob & Sons, Canada Limited, 260 Spadina Ave., Toronto 2b, Canada.

FOR SALE: 1—BANBURY "B" MIXER; 1—Farrel Birmingham 8" x 16" Chrome Plated 2-Roll Mill; 1—Baker-Perkins 100 gal. Sigma blade Mixer; 1—Baker Perkins size 16 TRM 150 gal. double arm Vacuum Mixer; 1—No. 1 Ball & Jewell Rotary Cutter; 2—Mikro Pulverizers, S. S. Bantam, #1 SH; 6—Stokes Model DD2, DS3, D3, and B2 Rotary Preform Presses, partial listing; we purchase your surplus. Brill Equipment Co., 35-55 Jabez St., Newark 5, N. J. Tel: Market 3-7420.

MOST MODERN PACKAGING AND PROCESSING MACHINERY: Available at great savings. Robinson Stainless Steel Double Arm Mixer for dry and viscous materials. Baker Perkins, W. & P. and Day Double Arm Steam Jacketed Heavy Duty Mixers—25, 50, 75, 100, 150 and 200 gal. capacities. Devine 650 gal. Jacketed Double Spiral Mixer. Day 2½ gal. MDA Mogul D.A. Vac Experimental Mixer. Fitzpatrick Models D, K-7 and K-8 Stainless Steel Comminuters. Werner & Pfleiderer 3,000 gal. and 3,500 gal. Jacketed Double Arm Mixers. Stokes Models R, RB-2 and DD2 and Eureka Tablet Machines. Colton 2RP, 3RP, 3B, 5½ T Tablet Machines. Mikro Pulverizers, Models 1SH, 2TH, 3TH and 4TH. Day, Robinson 50 to 10,000 lbs. Dry Powder Mixers, Jacketed and Unjacketed. Also wood and enamel. Day Imperial 75 gal. Double Arm Mixer, Sigma, Dispersion Blades. Package Machinery, Hayssen, Scandia, Wrap King, Campbell, Miller Wrappers. Standard Knapp, A-B-C, Ferguson Carton Sealers. Union Standard Equipment Company, 318 Lafayette Street, New York 12, N. Y. Phone: CAnal 6-5334.

Machinery Wanted

NEED TO BUY—A good, second-hand multiple platen compression molding hydraulic press, complete with adequate pressure to handle several platens. Must handle pieces 20" x 60" platen size. Reply Box 6642, Modern Plastics.

WANTED: LATE MODEL HPM 20 OZ. or 32 oz. prepasticiser machine forward complete data including price to American Molded Products Co., 2727 W. Chicago Ave., Chicago 22, Illinois.

WANTED TO BUY—6" to 8" EXTRUDER For compounding and pelletizing polyethylene and polystyrene. Minimum 20 to 1 L/D ratio. Must be in good condition. Wire, write or call. Plastic Trading Co. Inc., Winona, Minnesota, Phone 2318.

WANTED—4-6 REED PRENTICE-impcofellows, etc. Injection machines-late models-list particulars, Am principle. Reply Box 6626, Modern Plastics.

Materials For Sale

SURPLUS—PRIVATE PARTY

12000# Butyrate, Utility, Black M.H. Flow-Molding grade. All or part .35 per pound subject to prior sale. Reply Box 6638, Modern Plastics.

FOR SALE: PLEXIGLAS—G: SHEETS, orig. fact. packgs. excess inventory; up to 6 cases each. .187 Yellow 2037—48" x 72". .187 Red 2415—48" x 72". 16 sheets per case. At $.75 per sq. ft. F.O.B. Cont. U.S.A. Reply Box 6620, Modern Plastics.

CHEMSOL PLASTICS FOR QUALITY AND ECONOMY—Try our conventional and linear polyethylene in all colors, compounded from carefully selected feedstock. Also we make blends of conventional and linear polyethylene in desired ratios. No extra charge for blends or color matching. Exceptional values in black linear and conventional polyethylene in grinds or pellets. Nylon natural is priced very low and a substantial savings is offered on styrene medium and high impact in colors and high impact natural. Call or write Chemsol, Inc., 68 Clifford Street, Newark, N.J. MA 3-7515.

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FOR SALE: HAVE 10,000 SEATS and backs and desk tops plus seats for folding chair in plastic at quick bargain for cash, as is where is and will lump the lot. Also, thirty presses plus fifteen good compression molds as part of liquidation process. Cash only consideration. Reply Box 6643, Modern Plastics.

FOR SALE: SHINY BLACK REPROCESSED E/C 5000 lbs. jet black e/a 20 000 lbs. Many other materials at low, low prices. Reply Box 6635, Modern Plastics.

Materials Wanted

PLASTIC SCRAP WANTED—Styrene, Acrylic, Polyethylene, Butyrate, Acetate, Vinyl, Nylon, etc. We pay top dollar for your plastic scrap and surplus molding powders in any form. We also supply molding powders to the plastic industry at reasonable prices. Please contact for information. Philip Shuman & Sons, 571 Howard St., Buffalo 6, New York. Tel: MA 3111

GET THE TOP MONEY FOR PLASTIC SCRAP: Now paying top prices for all thermoplastic scrap. Wanted: polystyrene, cellulose, acetate, vinyl, polyethylene, butyrate, acrylic, nylon. All types and forms including rejects and obsolete molding powders. Fast action wherever you are located. WRITE, WIRE, TODAY! Reply Box 6637, Modern Plastics.

WANTED: PLASTIC OF ALL KINDS—virgin, reground, lumps, sheet and reject parts. Highest prices paid for Styrene, Polyethylene, Acetate, Nylon, Vinyl, etc. We can also supply virgin and reground materials at tremendous savings. Address your inquiries to: Gold-Mark Plastics Compounds, Inc., 4-05 26th Ave., Long Island City 2, N. Y. RAvenswood 1-0880.

Molds wanted

INJECTION MOLDS WANTED — Will purchase or lease molds. Must be houseware type items for consumer market. All-Power Plastics, 400 Roosevelt Ave., Montebello, California. RAymond 3-1165.

Molds for Sale

MOLDS (INJECTION) FOR SALE—All in excellent condition, ready for molding housewares, containers and covers. Some are brand new (duplicate) some are discontinued items. Will fit 8 and 12 oz. machines. Priced to move. Rogers Plastic Corp., W. Warren, Mass. HEmlock 6-7744.

FOR SALE: WE HAVE TEN good compression molds for compression molding. Our cost $75,000. Will sell at a bargain for cash. Even better for overseas use. Reply Box 6644, Modern Plastics.

Help Wanted

VACUUM MOLDING (BOATS)—Attractiv Production Management position open for an aggressive, responsible person capable of setting up and managing all phases of vacuum molding. State full qualifications, including previous employment and training, expected salary and personal references. Please reply in writing to Box 6624, Modern Plastics.

WANTED—QUALITY CONTROL man to setup and head inspection department in thermosetting plastic molding plant located in central New Jersey. Experience in molding and tool making helpful but not neccessary. All benefits paid, wages commensurate with ability. To be considered, send complete resume including history and salary requirement. Reply Box 6627, Modern Plastics.

WANTED—MOLD DESIGNER Experienced injection, compression and transfer mold designer. Please forward detailed resume of personal history, experience, and salary requirements to ABA Tool & Die Co., Inc., P.O. Box 75, Buckland, Conn.

WANTED—MANUFACTURERS REPRESENTATIVES—Large well-equipped injection plastic molder expanding custom operation. Seeking sales representatives to call on O.E.M. accounts, premium houses, subcontract, etc. Commission basis. Good opportunity for sales-producer to work into large volume proprietary lines. Enclose resume' and references with reply. Box 6640, Modern Plastics.

PRODUCT LINE SPECIALIST FOR EXTRUDED PLASTICS—Applicant should have knowledge of industrial uses and distribution of plastic sheets, strip, rod, tubing, and custom extruded profiles. New England home office and factory. National market. Excellent opportunity. Send resume to 6641, Modern Plastics.

POLYESTER RESIN SALES—Expanding organization with 3 new plants has opening for 4 salesmen to work on high salary plus commission. Do not reply unless you are aggressive and have definite sales contacts which can result in immediate business. Reply in confidence giving full details to C. J. Hauck, American Alkyd Industries, Carlstadt, N. J.

MANUFACTURER'S REPRESENTATIVE—Have several exclusive territories open in East and Midwest for sale of leading Blow Molding machines. This rapidly expanding organization requires additional men to handle increased sales. Must have experience in selling capital equipment to both small and large firms in Plastics Industry. Include details on background, other lines handled, and current territory covered. Reply Box 6629 Modern Plastics.

P.V.C. FORMULATION AND PLASTICS engineer required by a leading internationally known southern California pharmaceutical manufacturer. Degree in Engineering or Chemistry necessary. Candidate must be familiar with the formulation of polyvinyl chloride for extrusion and for plastisols. Familiarity with machinery for extrusion, injection molding, and dipping is desirable. Position will also involve responsible project work in the interesting field of hospital products. Excellent opportunity with growing company in pleasant nonindustrial surroundings. Send resume and salary requirements in strict confidence to Donald F. Adams, Personnel Administrator, Don Baxter, Inc., 1015 Grandview Avenue, Glendale 1, California.

PRODUCTION MANAGER CALENDERED VINYL FILM—Plant near Philadelphia calendering lightweight vinyl plastic film seeks top-flight production manager to supervise all operations. Must be thoroughly experienced with all phases of vinyl film production and formulation. Top salary. Write full particulars, in confidence. Reply Box 6623. Modern Plastics.

PLASTIC PACKAGING SALESMEN WANTED—N. Y., Chi., & La. Areas. Excellent opportunity offered by world leading manufacturer of Vinyl & Textile—Pouches, Kits, Bags, Cases, etc. Salary plus commission or straight Commission. Full resume—correspondence confidential. Yippco, 187 Saw Mill River Road, Yonkers, N. Y.

GENERAL MANAGER—REINFORCED PLASTICS experience in electronic missile and or automotive field. Substantial New England company wishes to enter the reinforced plastics field. We are looking for a man around whom we can build a technically competent organization to manufacture reinforced plastic products for electronics, aircraft, missile and automotive fields. This man must have prior experience in this area, preferably an engineering background, and definite administrative ability. This man will essentially operate his own business. We will offer excellent salary, plus bonus and stock option arrangements. Complete resume, is requested. Reply Box 6617, Modern Plastics.

PLASTICS ENGINEERS—Openings in Applications Research Laboratory in North Jersey metropolitan area. Degree in Chemistry, Chemical or Mechanical Engineering required; thermoplastic or thermosetting experience desirable. Position involves laboratory applications work and customer service. Liberal company benefits. Please send complete resume and salary requirements to B. T. McMillan, Laboratory Director, Plastics & Coal Chemicals Division, Allied Chemical Corp., 1 River Road, Edgewater, New Jersey.

EXCEPTIONAL OPPORTUNITY—For experienced man to develop polyester resin market among midwest reinforced plastic fabricators. This is a real challenge for the right man. He will be an integral part of a new products program carried out by a rapidly expanding national resin and chemical coatings producer. Must have five to ten years active experience selling in the reinforced plastics or allied products field. Send resume and salary requirement to Box 6619, Modern Plastics.

CHEMIST OR CHEMICAL ENGINEER—Chemist or chemical engineer to supervise production and development of phenolic resins and compounds and to work with sales on technical service. New England location. Replies confidential. Send complete resume, including salary and experience to H. L. Ebert, Chief Chemist, Firestone Rubber & Latex Products Company, Box 2290, Fall River, Mass.

TECHNICAL SALES REPRESENTATIVE—Attractive and interesting opening for a young technical representative to join the Pigments Division of a progressive company. Must have imagination, initiative and know how in Plastics and Coating Industries. New Jersey location, extensive travel after thorough training. Write for interview enclosing resume and present salary. Reply Box 6612, Modern Plastics.

WANTED—FOREMAN, PRESSMAN & MACH. OPERATORS on poly bag mach. Excellent opportunities for the right men. Call DI 5-5900 8 A.M. to 5:30 P.M. After 6 P.M. to 9 P.M. FA 7-3972

PLASTICS ENGINEER—Fast growing injection molding firm has position for young engineer with at least two years experience with injection molding. Responsibilities include product design, mold design, estimating and customer contact. Location—Central Connecticut. Reply Box 6614, Modern Plastics.

WANTED — SUPERVISOR FOR COMPRESSION MOLDING department with at least five years supervisory experience in general precision custom molding. Reply Olympic Plastics Company, Inc., 3471 So. La Cienega Bldg., Los Angeles 16, Calif.

ASSISTANT TO EXPORT SALES MANAGER—Fully experienced in world-wide export sales of thermoplastic resins. Dynamic, mature, sound-thinking individual. College graduate preferred but not essential. Write in detail about background and salary requirements. Metropolitan New York City area. Replies held in strict confidence. Reply Box 6621, Modern Plastics.

LAMINATING—We have 20x20, 32x32, 48x58—5 opening, hydraulic presses, heated platens, pumps, high pressure boiler, two 24" roller laminating and one Abbott 30x30 vacuum forming machines. We want someone with know-how for R&D and production. Will consider any arrangement starting with low salary plus. Kingsley Mfg., 4525 St. Clair Ave., Cleveland, Ohio.

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INJECTION MOLDING SUPERVISOR —Need experienced man with know how of plastic molding operations. To take full responsibility for the operation of our expanding injection facilities. Company well established in plastics and related fields. Salary commensurate to experience, profit sharing, stock purchase and other benefits. Chance to grow along with Company. Located in Southern California. All replies will be considered promptly and held in strictest confidence. Reply Box 6622, Modern Plastics.

ENGINEERING AND PRODUCTION openings for men with experience in extrusion, blowmolding, and compression molding. Apply Olympic Plastics Company, Inc., 3471 So. LaCienega Blvd., Los Angeles 16, Calif. Phone UPton 0-1121.

SALES ENGINEER—extrusion experience preferred for New York Area. Anchor Plastics Co., 36-35 35 St., L.I. City, N.Y.

FIBERGLASS PLASTIC TOOLING AND parts: Custom manufacturer of epoxy resin and polyester resin reinforced plastic tools and parts needs representatives in many states. Company's products are well received and name is well respected. A young industry with a very good future. Latrobe Plastic Company, 310 Unity Street, Latrobe, Pennsylvania.

CHEMICAL ENGINEERS, CHEMISTS—Excellent career opportunities in applied research and development. 1. Creative thinking wanted. 2. Complete laboratory facilities available. 3. Good income. 4. Attractive employee benefits. Emphasis on organic or physical chemistry desirable. Experience in vinyl compounding including plastisols, organosols and other film forming polymers beneficial. These attractive positions are with the expanding engineering and research division of multi-plant corporation with General Offices located in Central Ohio. You will like the suburban type living available in this small, progressive city of approximately 30,000. All replies strictly confidential. Send resume and salary requirements to Box 6631, Modern Plastics.

REPRESENTATIVES—presently contacting injection molders to profitably sell the ADCO line of replacement parts and repair service for injection molding machines. Your efforts supported by regularly scheduled magazine advertising, direct mailings, brochures, etc. See our advertisement this issue. Choice territories open. Adco Engineering & Mfg. Co., 2133 Lincoln Ave., Chicago 14. Eastgate 7-6678. Chas. Rank or Allerton Dee.

WANTED: SALES REPRESENTATIVE—Nationally know plastic sheeting manufacturer has excellent opportunities open for right men in Metropolitan New York, New York State, Central Atlantic States, and Midwest territories. College education and engineering background desirable, but consideration will be given to practical technical experience. Salary and incentive. Car and travelling expenses furnished. Travel required. Send resume to Box 6632. Modern Plastics.

PLASTICS ENGINEER—with a thorough knowledge of injection molded tool design and maintenance, and trouble shooting ability. Reply Box 6634, Modern Plastics.

PROCESS ENGINEER — Experienced Chemical Engineer with background in manufacturing processes involving thermosetting and thermoplastic products. Familiarity with molding and forming operations needed. Plastic foaming experience helpful. Opportunity with national manufacturer of capital products and fiber-reinforced translucent plastic panels to work in quality control functions, recommend and assist in improving processes, procedures and production methods, recommend and assist in product development, product testing, experimentation and pilot production. B. S. Degree as minimum formal training required. Chemical Engineer preferred. Three to five years minimum experience. Progressive, growth minded Company; modern facilities active research program; attractive opportunity for well-qualified candidate. Please send confidential letter and resume to Orval W. Groves, Employment Supervisor, Butler Manufacturing Company, 7400 East 13th Street, Kansas City 26, Missouri. Interviews will be arranged with qualified applicants.

POLYMER CHEMISTS—M.S. or Ph.D., recent graduates, for advanced development of special purpose casting resins. Freedom to follow problems of individual interest is encouraged with moderate amounts of time being spend in consultation with design engineers concerning the proper utilization of materials in specific designs. Prove-in of new materials involves construction of laboratory prototypes, follow-up on pilot-plant runs and some production trouble shooting. Complete analytical chemical, physical testing, and electrical measurements laboratories are available to support the individual in these efforts. Sandia Corporation, located in Albuquerque, N. M., offers excellent working and living conditions and generous employee benefits, including liberal holidays and vacations, retirement and insurance plans, and graduate educational aid programs. Mail resume in complete confidence to: Professional Employment Section 597. Sandia Corporation, Albuquerque, New Mexico.

SALES AGENTS—with good background and suitable contacts for promotion of highest quality black and brown urea and melamine molding compounds required. Eastern and Midwestern territory open. Commission arrangements. Reply with full details, Box 6636, Modern Plastics.

HIGH PRESSURE SHEET LAMINATES —Due to illness of owner, top production supervisor needed to assume complete charge laminating dept. Press operation exp. essential. Responsible for quality cost and personnel. Our plant consists of 6 multiple opening 200 lb. pressure laminating presses, air piston presses, transfer moulding, vacuum forming and heat sealing machines. Excellent opportunity qualified person. Factory located vicinity New York City. Detailed resume Box 6645, Modern Plastics.

Situations Wanted

PLASTIC ENGINEER—14 years experience Manufacturing Research and Development, Tool Engineering and Production supervision. Extensive knowledge, Fabricating hi-temperature, ablative reinforced laminates. Diversified experience, high and intermediate pressure molding, autoclave, centrifugal casting, and vacuum molding. Desires challenging position with a progressive company. Reply Box 6628, Modern Plastics.

Miscellaneous

PRESS TIME AVAILABLE—Two new flat bed high pressure presses available for reinforced plastic moulding. Platens to 4' by 12'. Ideal for flat or shaped plastic products, custom moulding. Cost plus basis quotes available. Reply Box 6613, Modern Plastics.

FOR EXPORT: Button dies and miscellaneous molding equipment available for export. Write Merit Plastics, 30 Lincoln Place, Lynnbrook, N. Y.

OLD ESTABLISHED BRITISH Injection Moulding Company, is desirous of contacting American Plastic manufacturers with a view to producing thermoplastic mouldings of American origin in Great Britain. Royalty or other suitable arrangements to be negotiated. We have several such agreements already in operation. A Director is visiting U.S.A. in September/October and will be pleased to discuss projects. Please write—Sales Director, Injection Moulders Ltd., Westmoreland Road, London, N.W.9., England.

CONTRACT WORK WANTED — Compression Molder with excess capacity desires contract work. Battery of 150 and 200 Ton Stokes presses. Metropolitan New York City area. Reply Box 6615, Modern Plastics.

SUCCESSFUL SALES ORGANIZATION Available for Eporters to Benelux. Here's a rare opportunity for someone seeking a distribution set-up in the Benelux area! For 12 years, with great success, our firm has represented one of the largest U.S. producers of plastic materials. Only because they are setting up their own organization, we will lose one of our major products. We are seeking new plastic and chemical lines. Excellent references. Offices in Brussels and Rotterdam. Write IMEXIN S.A., 5, Av. de Broqueville, 15, Brussels, Belgium.

FOR SALE—OPERATING FLORIDA CORPORATION Plastic application plant for corrosion protection located in central industrial region where severe corrosion is prevalent. Operation established in 1958. New, modern and well-equipped plant with room for expansion. Experienced sales and production staff now serving numerous bluechip repeat customers. President and principal stockholder (90%) must sell because of inability to devote sufficient administrative time, due to other Northern interests. Present investment approximately $100,-000. An excellent opportunity with unlimited potential for a company desiring to establish Florida operation. Reply Box 6633, Modern Plastics.

WANTED—MANUFACTURER OF PROPRIETARY PRODUCT LINE. A large midwest plastic molder interested in acquiring a concern who manufactures and merchandises active line of proprietary products preferably in sporting goods field. Must have good merchandising organization. Management in both sales and production will be retained. Would expect to broaden and consolidate line of products. Interested only in progressive and successful organization. Reply Box 6618, Modern Plastics.

CAPITAL AVAILABLE—We want to purchase an interest in or control of plastics company with growing future. Also interested in men with ideas to serve as basis for forming such a company. Reply Box 6616, Modern Plastics.

HAVE MOLDS AND WORK for 4 machines. Looking for proposition with competent injection molder. Prefer small or medium operation. List particulars. Metropolitan area preferred. Reply Box 6625, Modern Plastics.

RATES FOR CLASSIFIED ADVERTISING

All classified advertisements payable in advance of publication

Closing date: 10th of preceding month, e.g., Sept. 10th for Oct. issue

Per inch (or fraction ... $30.00; each 3 inches or fraction (in border) $15.00 extra

Situations Wanted Ads ... 1/3 of above rates

For purpose of establishing rate, figure approximately 50-55 words per inch. For further information address Classified Advertising Department, Modern Plastics, 575 Madison Avenue, N. Y. 22, N. Y. Modern Plastics reserves the right to accept, reject or censor classified copy.

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EDITORIAL

Plastics in the new nations

New countries are generally underdeveloped countries, and the fact that plastics are recognized as contributing vastly to high standards of living in the Western world, causes in entrepreneurs and governments of these countries a desire to get into plastics fast.

How should an underdeveloped nation with teeming population and great resources, but no money and little or no industry, go about developing a plastics industry of its own? Should it attempt to build big chemical plants for the making of raw materials and hope later to create processing facilities? Or should it develop molding, extruding, laminating facilities and skills, and plan later on to build materials plants to serve the processors? Should it create a separate plastics industries entity or should it link plastics materials production and processing to existing industries, such as fertilizer manufacture, paper and textile production, metal production, etc.?

We have witnessed the application of plastics in some underdeveloped countries and it is sad indeed to note that, through cottage industry, people are being supplied with baubles, bangles, spangles, and beads out of available materials that could be used for better purposes.

The people in underdeveloped nations need food, clothing, and shelter as a basis on which, through education, to achieve higher standards of living.

So, we would exhort the economic planners in these new nations to give thought to pipe and film for agriculture, fibers for textiles, foams and reinforced plastics for building.

Almost all these nations have big production of agricultural fibers such as jute, sisal, ramie, cane, any and all of which can be combined with various plastics resins, foams and sheets to produce building panels, which can be flame resistant, rot-resistant, termite proof and durable in warm climates. With the new technique of spray-up in both foams and reinforced plastics, relatively unskilled labor can be used in this field.

Because the climate in most of these lands is warm, plastics piping for water services and plastics plumbing facilities should be practical. Where glass is not available for fenestration, plastics films and panels can be used. Plastics flooring is sanitary, durable, and beautiful.

There is a great opportunity for leaders in the new nations to establish plastics industries that will contribute mightily to their national progress.

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